COMMUNICATION FOR ARMOR

ARMOR
The Combat Arm of Decision

US ARMY ARMOR SCHOOL

1960

Suggestions or comments relative to the form, contents, purpose, or use of this booklet are invited and should be addressed to the Director, Communication Department, US Army Armor School, Fort Knox, Kentucky.

The purpose of this booklet is to present, in concise form, the information needed in planning and establishing communication with the signal equipment now being issued to armor units. This booklet does not in any manner replace technical manuals or field manuals.

This publication is provided for resident and extension course instruction at the United States Army Armor School only. It reflects the current thought of the Armor School and conforms to printed Department of the Army doctrine as closely as possible.

TAKE CARE OF YOUR EQUIPMENT
THE DOLLAR YOU SAVE
MAY BE YOUR OWN

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Section I. ABBREVIATIONS AND DEFINITIONS

1. ABBREVIATIONS COMMONLY USED WITH ARMOR COMMUNICATION

AC	alternating current
ACP	Allied Communications Publication
ACT	air control team
AF	audio frequency
AFC	automatic frequency control
ALO	air liaison officer
AM	amplitude modulated
amp	ampere
AN/ARC	Airborne radio communication
AN/GRA	Ground radio auxiliary, assemblies
AN/GRC	Ground radio communication
AN/GRR	Ground radio receiver
AN/GSA	Ground special auxiliary, assemblies
AN/PRC	Portable radio communication
AN/TTC	transportable telephone (wire) communication
AN/VRC	vehicular radio communication
AN/VRQ	vehicular radio special
ant	antenna
armd	armored
arty	artillery
aux	auxiliary
AVC	automatic volume control
BFO	beat frequency oscillator
bn	battalion
carr	carrier
cav	cavalry
CB	common battery (operation)
CBS	common battery signaling
CO	commanding officer
CMI	command maintenance inspection
comd	command
comm	communication
Comm Off	communication officer
CommC	communication chief
CommZ	communications zone
CP	command post
CPX	command post exercise
cps	cycles per second
crypto	cryptographic
CW	continuous wave
DC	direct current
div	division
DLCC	division logistical control center
DR	drum
E	voltage
f	frequency
F	fuse
FA	field artillery
FAC	forward air controller
FAX	facsimile
FDC	fire direction center
FM	frequency modulated
FM	field manual
FO	forward observer
FSCC	fire support coordination center
FSK	frequency shift keying
FSN	federal stock number
Fwd	forward
gp	group
HF	high frequency
HQ	headquarters
HV	high voltage
hy	henry
I	current
IF	intermediate frequency
inf	infantry
int	interphone
intel	intelligence
IPA	intermediate power amplifier
J	jack
JAN	Joint Army-Navy
JANAP	Joint Army-Navy Air Force Publication
kc	kilocycle
kv	kilovolt
kw	kilowatt
LB	local battery
LF	low frequency
ln	liaison
log	logistical
LS	loud-speaker
LV	low voltage
M	message, meter, modulated
ma	milliampere
maint	maintenance
mc	megacycle
MCW	modulated continuous wave
meg	megohm
mfd	microfarad
mhy	millihenry
MIC	microphone
mm	millimeter
mmf	micromicrofarad
MO	master oscillator
MOPA	master-oscillator power-amplifier
msg	message
MSR	main supply route
mv	millivolt
MVC	manual volume control
mw	milliwatt
MWO	modification work order
NCS	net control station
OSC	oscillator
P	power
PA	power amplifier
plat	platoon
RC	resistance-capacitance
rcvr	receiver
RF	radio frequency
RL	reel unit
RM	radioman mechanic
RT	receiver-transmitter
ROCAD	reorganization of current armored division
ratt	radioteletype

r.p.m.	revolutions per minute
SB	supply bulletin
SIG	signal
SigC	Signal Corps
SOI	signal operating instructions
SOP	standing operating procedure
SPDT	single-pole double-throw
SPST	single-pole single-throw
sq	squadron
sqd	squad
SSB	single side band
SSI	standing signal instructions
sw	switch
swbd	switchboard
T	transformer
TA	table of allowances
TASSA	The Army Signal Supply Agency
TB	technical bulletin
TD	table of distribution
TE	tool equipment
tel	telephone
TF	task force
TM	technical manual
tn	trains
TRF	tuned radio frequency
TOE	table of organization and equipment
TSC	tactical support center
UER	unsatisfactory equipment report
UHF	ultra high frequency
v	volt
VHF	very high frequency
VM	voltmeter
vol	volume
VOM	volt-ohm-milliameter
VTVM	vacuum tube voltmeter
Xmtr	transmitter
XO	executive officer
Ω	Ohm

2. DEFINITIONS

The following terms are commonly used with armor communication.

Absorption. The loss of radiated energy due to effects of ground, atmosphere, and surrounding objects.

Amplification. The process of increasing the electrical strength of a signal.

Amplitude. The strength of a signal.

Amplitude modulation. The process of varying the amplitude of a carrier in accordance with the modulating intelligence.

Antenna. An electrical conductor or a system of conductors used to radiate or receive radio waves.

Array (antenna). An arrangement of antenna elements, usually dipoles, to achieve desirable directional characteristics.

Attenuation. The reduction in strength of a signal.

Audio frequency. A frequency corresponding to an audible sound wave, usually from 16 to 16,000 cycles per second.

Authentication. A security measure designed to protect a communication system against fraudulent messages originated by the enemy.

Automatic retransmission. A process in which a station acting as a relay point receives a transmission and automatically retransmits this signal to another station.

Band of frequencies. The range of frequencies between two specified limits.

Carrier frequency. The frequency of the unmodulated carrier wave.

Channel frequency. A frequency designated for transmission and/or reception of radio signals.

Coaxial cable. A transmission line consisting of one conductor, usually a small copper tube or wire, within and insulated from another conductor of larger diameter, usually copper tubing or copper braid. Radiation from this type of line is negligible. Coaxial cable is also called concentric line.

Common battery operation. A telephone system in which current for both signaling and talking is supplied from a central source.

Common battery signaling (CBS). A telephone system in which the current to signal each telephone is supplied from a central source. Current for talking is furnished locally.

Conductivity. The relative ability of a material to allow the flow or passage of an electric current.

Continuous wave. Radio waves that maintain a constant amplitude and constant frequency.

Cross-modulation. Modulation of a desired signal by an undesired signal.

Decibel (db). The standard unit of comparison of signal strengths based on the logarithmic response of the human ear.

Demodulation. The process of recovering the audio component (audible signal) from a modulated rf carrier wave.

Detent tuning. A mechanical method of selecting channels by feel and audible click. A similar method is employed to select stations on a TV set.

Dielectric. An insulating material between the plates of a capacitor.

Dipole antenna. An antenna with an overall length of ½ wave. The antenna is composed of two metallic radiating elements separated by an insulator at a point where the transmission line is connected.

Distortion. Distortion is said to exist when the output wave form is not a true reproduction of the input wave form. Distortion may exist because of transmission or amplification irregularities in amplitude, frequency, or phase.

Doublet antenna. A simple directional antenna constructed to provide extended range for stationary radio sets.

Duplex operation. Simultaneous transmission and reception of intelligence.

Electromagnetic field. The magnetic field that an electric current produces around the conductor through which it flows.

Fading. Variations in the strength of a received radio signal caused by changes in the characteristics of the propagation or transmission medium.

Frequency. The number of complete cycles per second existing in any form of electrical or sound wave motions.

Frequency distortion. Distortion that occurs as a result of failure to amplify or attenuate equally all frequencies present in a complex wave.

Frequency modulation. The process of varying the frequency of an rf carrier wave in accordance with the amplitude and frequency of an audio signal.

Frequency shift keying (FSK). The process of shifting a carrier frequency in accordance with keying signals. May be used as a method of transmitting RTT or facsimile.

Ground. Term applied to the earth as a conductor. A metallic common-return conductor associated with a circuit. A metallic connection with the earth to establish ground potential.

Ground wave. That portion of a transmitted radio wave that travels near the surface of the earth.

Ground return circuit. Telephone or telegraph circuit in which one side is metallic and the other is the physical earth.

Interference. An electrical disturbance from any source which causes undesirable responses in electronic equipment.

Ionosphere. Highly ionized layers of atmosphere (between the altitudes of approximately 35 and 250 miles) which affect the propagation of radio waves.

Jamming. Deliberate blocking or impairing of radio reception by means of interfering electrical radiation.

Line of sight communication. Communication over a point-to-point unobstructed path.

Local battery operation. A telephone system in which the talking and signaling current is supplied locally by each telephone.

Local circuit. A wire circuit connecting a telephone to a switchboard.

Maintenance. All action taken to retain materiel (including communication equipment) in a serviceable condition or to restore same to serviceability.

Mega. A prefix meaning one million.

Micro. A prefix meaning one-millionth.

Microphone. A device used to change mechanical sound vibrations into electrical energy.

Modulated carrier. An RF carrier whose amplitude and frequency have been varied in accordance with the intelligence to be conveyed.

Modulation. The process of varying the amplitude or the frequency of a carrier wave in accordance with other signals in order to convey intelligence.

Modules. Small plug-in subassemblies for electronic equipment.

Monitoring. The process of guarding a channel or means of communication in order to be aware of the existence and content of all transmissions.

Net. A designated system, consisting of two or more stations, able to communicate with each other.

Phantom circuit. Telephone or telegraph circuit obtained by superimposing an additional circuit on two existing circuits.

Preventive maintenance indicators. Selected inspection points which indicate, but do not completely establish or confirm, the preventive maintenance status of the equipment.

Point-to-point circuit. A nonswitched communication path between two definite fixed terminal stations.

Power supply. A major radio component used to convert a primary source of power to the different operating voltages required for receiver and transmitter operation.

Radiate. To send energy into space, as in the case of rf waves.

Radio calibration. The procedure used to correct the dial settings of a radio.

Radio frequency. Any frequency above the audio range that is used for transmitting intelligence.

Radio repeater set. A combination radio transmitter and receiver used in relaying intelligence from one station to another when the distance is too great for reliable service directly between the stations.

Radio terminal set. Radio set designed to give two-way service as a receiving and transmitting terminal (to or with a radio repeater or other terminal). It may contain necessary wideband modulation or associated carrier multiplexing equipment.

Reflection. The turning back of a radio wave from a metallic object, the surface of the earth, or the ionosphere with the angles of incidence and reflection equal and lying in the same plane.

Relay. A process of retransmitting intelligence through an intermediate station.

Repeater. Equipment utilized for the reception, amplification, and retransmission of intelligence.

Signal operating instructions. A series of orders, subject to frequent change, issued for technical control and coordination of the signal communication activities of a command.

Standing signal insrructions (SSI). Contains instructions not subject to frequent change, necessary for the operation of signal communication equipment, agencies, and means. Instructions for the use of data in the SOI are contained in the SSI.

Skip distances. The distances on the earth's surface between the points where a radio sky wave is successively reflected between the earth and the ionosphere.

Simplex operation. A method of operation in which communication between two stations takes place in one direction at a time.

Siting. Locating an antenna or radio set to meet the requirements of the situation.

Single side band. A type of radiotelephone service in which a group of side bands (either the upper or lower) is completely eliminated and the transmitted carrier is completely or partially suppressed.

Squelch control. A control for eliminating background noise in an FM receiver when no station in the net is transmitting.

Transistor. A small crystalline semiconductor device which replaces a vacuum tube in many applications.

Transmission line. Any conductor or system of conductors designed to carry electrical energy.

Trunk circuit. A circuit connecting two switchboards.

Tuning. The process of adjusting radio circuits to enable equipment to operate on a definite frequency.

Wave length. The distance in meters traveled by a wave during the time interval of one complete cycle. It is equal to the velocity divided by the frequency.

Zero beat. A condition existing when two equal frequencies are mixed producing no audible sound.

Section II. EQUIPMENT NOMENCLATURE

3. "AN" NOMENCLATURE SYSTEM

a. Examples of "AN" Type Numbers.

Type Number	*What the Number Indicates*
AN/SRC-3( )	General reference set nomenclature for water surface craft radio communication set Nr 3.
AN/SRC-3	Original procurement set nomenclature applied against AN/SRC-3( ).
AN/SRC-3A	Modification set nomenclature applied against AN/SRC-3.
AN/APQ-13-T1( )	General reference training set nomenclature for the AN/APQ-13 set.
AN/APQ-13-T1	Original procurement training nomenclature applied against AN/APQ-13-T1( ).
AN/APQ-13-T1A	Modification training set nomenclature applied against AN/APQ-13-T1( ).
AN/UPT-T3( )	General reference training set nomenclature for general utility radar transmitting training set Nr 3.
AN/UPT-T3	Original procurement training set nomenclature applied against AN/UPT-T3( ).
AN/UPT-T3A	Modification training set nomenclature applied against AN/UPT-T3.
T-51( )/ARQ-8	General reference component nomenclature for transmitter Nr 51, part of or used with airborne radar special set Nr 8.
T-51/ARQ-8	Original procurement component nomenclature applied against T-51( )/ARQ-8.
T-51A/ARQ-8	Modification component nomenclature applied against T-51/ARQ-8.
RD-31( )/U	General reference component nomenclature for recorder-reproducer Nr 31 for general utility use, not part of a specific set.
RD-31/U	Original procurement component nomenclature applied against RD-31( )/U.
RD-31A/U	Modification component nomenclature applied against RD-31/U.

b. Explanation.

Note. The information in *a*, above, formerly was included in a chart titled *"Summary of Joint Army-Navy Nomenclature System ("AN" System) for Communication and Associated Equipment."*

(1) The system indicator "AN" does not mean that the Army, Navy, and Air Force use the equipment but simply that the type number was assigned in the "AN" system.

(2) In the "AN" nomenclature system, the nomenclature consists of a name followed by a type number. The type number will consist of indicator letters shown in *a*, above, and an assigned number.

(3) The type number of an independent component that is not part of or used with a specific set will consist of a component indicator, a number, the slant, and such of the set or equipment indicator letters as apply. For example, SB-5/PT would be the type number of a portable telephone switchboard for independent use.

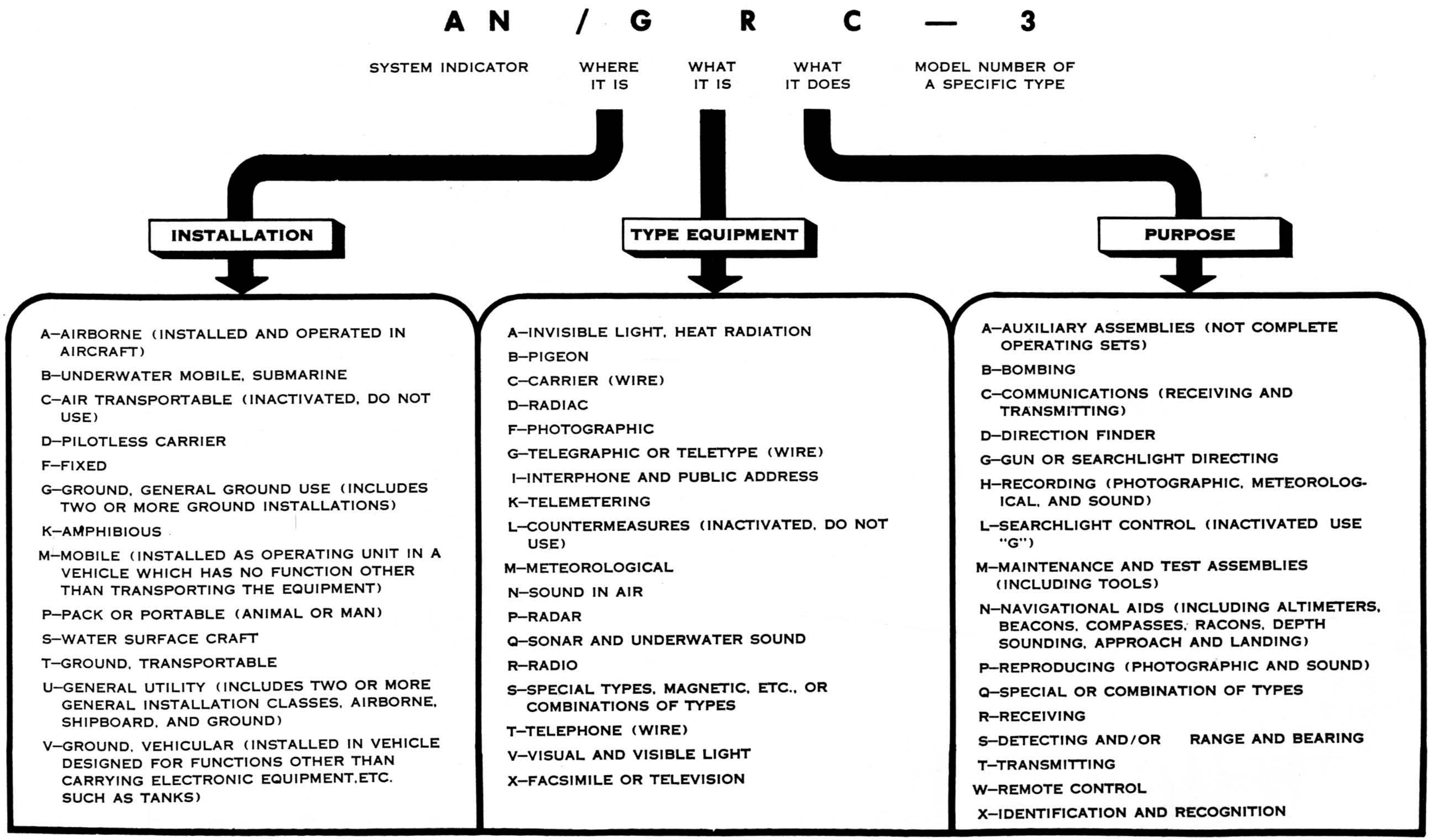
(4) All requests for nomenclature assignments will be submitted on an approved form and in accordance with the joint *Army-Navy Manual of Standard Descriptions* (JAN-P-109), or superseding Munitions Board Cataloging Agency publications.

c. *Modification Letters.*

(1) Component modification suffix letters will be assigned for each modification of a component when detail parts and subassemblies used therein are no longer interchangeable, but the component itself is interchangeable physically, electrically, and mechanically.

(2) Set modification letters will be assigned for each modification not affecting interchangeability of the sets or equipment as a whole, except that in some special cases they will be assigned to indicate functional interchangeability and not necessarily complete electrical and mechanical interchangeability. Modification letters will be assigned only if the frequency coverage of the unmodified equipment is maintained.

(3) The suffix letters, X, Y, and Z will be used only to designate a set or equipment modified by changing the input voltage phase or frequency. X will indicate the first change, Y the



AN / G R C — 3

SYSTEM INDICATOR

WHERE IT IS

WHAT IT IS

WHAT IT DOES

MODEL NUMBER OF A SPECIFIC TYPE

INSTALLATION

A–AIRBORNE (INSTALLED AND OPERATED IN AIRCRAFT)
B–UNDERWATER MOBILE, SUBMARINE
C–AIR TRANSPORTABLE (INACTIVATED, DO NOT USE)
D–PILOTLESS CARRIER
F–FIXED
G–GROUND, GENERAL GROUND USE (INCLUDES TWO OR MORE GROUND INSTALLATIONS)
K–AMPHIBIOUS
M–MOBILE (INSTALLED AS OPERATING UNIT IN A VEHICLE WHICH HAS NO FUNCTION OTHER THAN TRANSPORTING THE EQUIPMENT)
P–PACK OR PORTABLE (ANIMAL OR MAN)
S–WATER SURFACE CRAFT
T–GROUND, TRANSPORTABLE
U–GENERAL UTILITY (INCLUDES TWO OR MORE GENERAL INSTALLATION CLASSES, AIRBORNE, SHIPBOARD, AND GROUND)
V–GROUND, VEHICULAR (INSTALLED IN VEHICLE DESIGNED FOR FUNCTIONS OTHER THAN CARRYING ELECTRONIC EQUIPMENT,ETC. SUCH AS TANKS)

TYPE EQUIPMENT

A–INVISIBLE LIGHT, HEAT RADIATION
B–PIGEON
C–CARRIER (WIRE)
D–RADIAC
F–PHOTOGRAPHIC
G–TELEGRAPHIC OR TELETYPE (WIRE)
I–INTERPHONE AND PUBLIC ADDRESS
K–TELEMETERING
L–COUNTERMEASURES (INACTIVATED, DO NOT USE)
M–METEOROLOGICAL
N–SOUND IN AIR
P–RADAR
Q–SONAR AND UNDERWATER SOUND
R–RADIO
S–SPECIAL TYPES, MAGNETIC, ETC., OR COMBINATIONS OF TYPES
T–TELEPHONE (WIRE)
V–VISUAL AND VISIBLE LIGHT
X–FACSIMILE OR TELEVISION

PURPOSE

A–AUXILIARY ASSEMBLIES (NOT COMPLETE OPERATING SETS)
B–BOMBING
C–COMMUNICATIONS (RECEIVING AND TRANSMITTING)
D–DIRECTION FINDER
G–GUN OR SEARCHLIGHT DIRECTING
H–RECORDING (PHOTOGRAPHIC, METEOROLOGICAL, AND SOUND)
L–SEARCHLIGHT CONTROL (INACTIVATED USE "G")
M–MAINTENANCE AND TEST ASSEMBLIES (INCLUDING TOOLS)
N–NAVIGATIONAL AIDS (INCLUDING ALTIMETERS, BEACONS, COMPASSES, RACONS, DEPTH SOUNDING, APPROACH AND LANDING)
P–REPRODUCING (PHOTOGRAPHIC AND SOUND)
Q–SPECIAL OR COMBINATION OF TYPES
R–RECEIVING
S–DETECTING AND/OR RANGE AND BEARING
T–TRANSMITTING
W–REMOTE CONTROL
X–IDENTIFICATION AND RECOGNITION

Figure 1. Interpretation of joint nomenclature system.

second, Z the third, XX the fourth, etc., and these letters will be in addition to other modification letters applicable.

d. Additional Indicators.

(1) *Experimental sets.* In order to identify a set or equipment of an experimental nature with the development organization concerned, the following indicators will be used within the parentheses:

(*a*) XA–Air Materiel Command, Headquarters, Dayton, Ohio.

(*b*) XB–Naval Research Labaratory, Washington, D.C.

(*c*) XC–Coles Signal Laboratory, Fort Monmouth, N.J.

(*d*) XE–Evans Signal Laboratory, Fort Monmouth, N.J.

(*e*) XG–USN Electronic Laboratory, San Diego, Calif.

(*f*) XM–Squier Signal Laboratory, Fort Monmouth, N.J.

(*g*) XN–Navy.

(*h*) XU–USN Underwater Sound Laboratory, Fort Trumbull, New London, Conn.

(*i*) XW–Watson Laboratories, AMC, Redbank, N.J.

Example. Radio Set AN/ARC-3( ) might be assigned for a new airborne radio communication set under development. The cognizant development organization might then assign AN/ARC-3(XA-1), AN/ARC-3(XA-2), etc., type numbers to the various sets developed for test. When the set was considered satisfactory for use, the experimental indicator would be dropped and procurement nomenclature AN/ARC-3 would be assigned thereto.

(2) *Training sets.* A set or equipment designed for training purposes will be assigned type numbers as follows:

(*a*) A set to train personnel to operate a specific basic set will be assigned the basic set type number followed by a dash, the letter T, and a number. For example, Radio Training Set AN/ARC-6A-T1 would be the first training set for Radio Set AN/ARC-6A.

(*b*) A set to train personnel to operate general types of sets will be assigned the usual set indicator letters followed by a dash, the letter T, and a number. For example, Radio Training Set AN/ARC-T1 would be the first training set for general airborne radio communication sets.

(3) *Parentheses indicator.* A nomenclature assignment with parentheses ( ) following the basic type number is made to identify an article generally, when a need exists for a more general identification than that provided by nomenclature assigned to specific designs of the article. Examples are AN/GRC-5( ), AM-6( )GRC-5, SB-9( )/GG. A specific design is identified by the plain basic type number, the basic type number with a suffix letter, or the basic type number with an experimental symbol in parentheses. Examples are AN/GRC-5, AN/GRC-5A, AN/GRC-5(XC-1), AM-6B/GRC-5, and SB-9(XE-3)/GG.

e. Nomenclature Policy.

(1) An AN nomenclature will be assigned to the following.

(*a*) Complete sets of equipment and motor components of military design.

(*b*) Groups of articles of either commercial or military design which are grouped for a military purpose.

(*c*) Major articles of military design which are not part of or used with a set.

(*d*) Commercial articles, when nomenclature will facilitate military identification and/or procedures.

(2) An AN nomenclature will *not* be assigned to:

(*a*) Articles cataloged commercially except in accordance with paragraph (1)(*d*), above.

(*b*) Major components of military design for which other adequate means of identification are available.

(c) Small parts such as capacitors and resistors.

(*d*) Articles having other adequate identification in joint military specifications.

(3) Nomenclature assignments will remain unchanged regardless of later changes in installation and/or application.

Caution. All personnel are cautioned against originating or changing any part of any nomenclature assignment, including modification letters, without authorization.

Section III. PRINCIPLES OF RADIO COMMUNICATION

4. INTRODUCTION

Radio is the primary means of communication within and between armor units. Radio is the link between the armor commander and his command, and through radio he is able to coordinate all activities of his command. The extensive use of radio within armor organizations makes it necessary for all armor personnel to have a general understanding of the capabilities, limitations, and peculiarities of radio communication. The following paragraphs give a general description of how intelligence is transmitted from a radio transmitter to a radio receiver.

5. RADIO WAVES

Radio signals travel from transmitter to receiver by the use of electromagnetic waves. These waves radiate at approximately 186,000 miles per second, a speed equal to that of light. The rapid radiation of these waves provides instant point-to-point communication. The electromagnetic waves are called *radio waves,* as they are used for radio signaling, and are classified according to frequency. Frequency is the number of complete cycles per second existing in any form of electrical or sound wave motion.

a. The classification of radio frequencies follows:

(1) Very low frequency (VLF)–3 to 30 kilocycles (kc) per second (1 kc equals 1000 cycles).

(2) Low frequency (LF)–30 to 300 kc per second.

(3) Medium frequency (MF)–300 to 3,000 kc per second.

(4) High frequency (HF)–3 to 30 megacycles (mc) per second (1 megacycle equals 1,000 kc).

(5) Very high frequency (VHF)–30 to 300 mc per second.

(6) Ultra high frequency (UHF)–300 to 3,000 mc per second.

(7) Super high frequency (SHF)–3,000 to 30,000 mc per second.

(8) Extreme high frequency (EHF)–over 30,000 mc per second.

b. Frequency classification does not extend below three kilocycles. This is because lower frequencies require considerable power to get the signal to travel any appreciable distance. The majority of stations operate in the bands from the *medium* through the *ultra high* frequencies; however, there are a few stations operating on frequencies in the very low frequency band for special purposes.

c. In order to understand why these frequencies are used, the propagation characteristics of different frequencies should be considered. Radiation is caused by varying currents traveling back and forth in the antenna. These currents cause an electromagnetic field to be built up around the antenna. This field will expand outward from the antenna at the previously indicated speed of 186,000 miles per second, and will vary in strength and frequency with the antenna currents.

d. Since the signal is radiating 360 degrees around the antenna, logically it will get weaker as it travels away from the antenna. Also, there normally are man-made or natural obstacles that will affect the transmitting range. A knowledge of these facts will increase understanding of the following explanation of the types of wave propagation as they affect military radio transmissions.

e. In figure 2 the ground wave is illustrated. Ground wave propagation is the most dependable under all atmospheric conditions and is used when distance permits. At low frequencies the ground wave extends for considerable distance but this distance decreases rapidly as the frequency is increased, so that any frequency above the HF band has a very limited ground wave transmission range.

f. Figure 2 also shows *line-of-sight* wave propagation. This method of transmission is available at all frequencies, but in VHF or UHF bands it is the only practical means of obtaining reliable communication with low or medium power. If obstructions appear in the line-of-sight path between the transmitting antenna and the receiving antenna, the signal becomes weak or is lost. Figure 3 shows how station siting affects communication systems using the line-of-sight path. Locating a radio behind a hill or obstruction will lower the signal strength, but note that this effect is decreased as the radio is moved farther away from the hill.

g. The type of propagation used for long-range communication is also shown in figure 2. This type of propagation is known as *Sky Wave.* Sky wave propagation over great distances is made possible by the existence of ionized layers in the upper atmosphere surrounding the earth. These layers act as a refractor to a certain band of frequencies and will cause the signal to bend back toward the earth and thereby be made available for reception at points beyond the horizon. Several "skips" may allow the signal to be received at distances of thousands of miles from the transmitter. The ionized layers are continually varying in contour and height so that fading effects are experienced at the distant reception points. Also, the layers rise during daylight hours and descend at night so that the distance of skips changes from day to night. It has been found that by using higher frequencies during daylight and lower frequencies at night, communication with a distant point may be maintained with considerable reliability. Frequencies between 4 and 25 megacycles are used for long-distance communication. Frequencies above 50 megacycles are most effective for line-of-sight operation. These frequencies tend to penetrate the ionized layers, thus minimizing the possibility of their use over long distances. No absolute dividing lines can be established as to the frequency at which the ground waves become ineffective, or when the sky waves are no longer usable and line-of-sight operation becomes necessary. The change from one method of propagation to another is gradual and is governed by frequency, terrain, and distance.

6. RADIO FREQUENCIES

A radio frequency is any frequency above the range of hearing. Radio frequencies begin between 16 and 17 kilocycles, and for all practical purposes have no upper frequency limit.

a. Armor AM radios use the high frequency band, which is effective on all three types of wave propagation. For short-range transmissions, the ground waves are used; from the transmitting station to the horizon, line-of-sight waves are used; and for transmissions over the horizon, reflected waves are used.

b. Armor FM radios also operate near the upper limits of the high frequency band, and tend towards line-of-sight operation, although ground waves will still be used for short-distance transmissions. Under certain atmospheric conditions, armor FM radio waves will take the form of sky waves and can be received at considerable distances. The possibility exists that these reflected waves may be detected by distant stations operating in the armor band, thus causing interference with their own communication. The atmospheric conditions which cause this effect cannot be controlled, but fortunately, seldom occur.

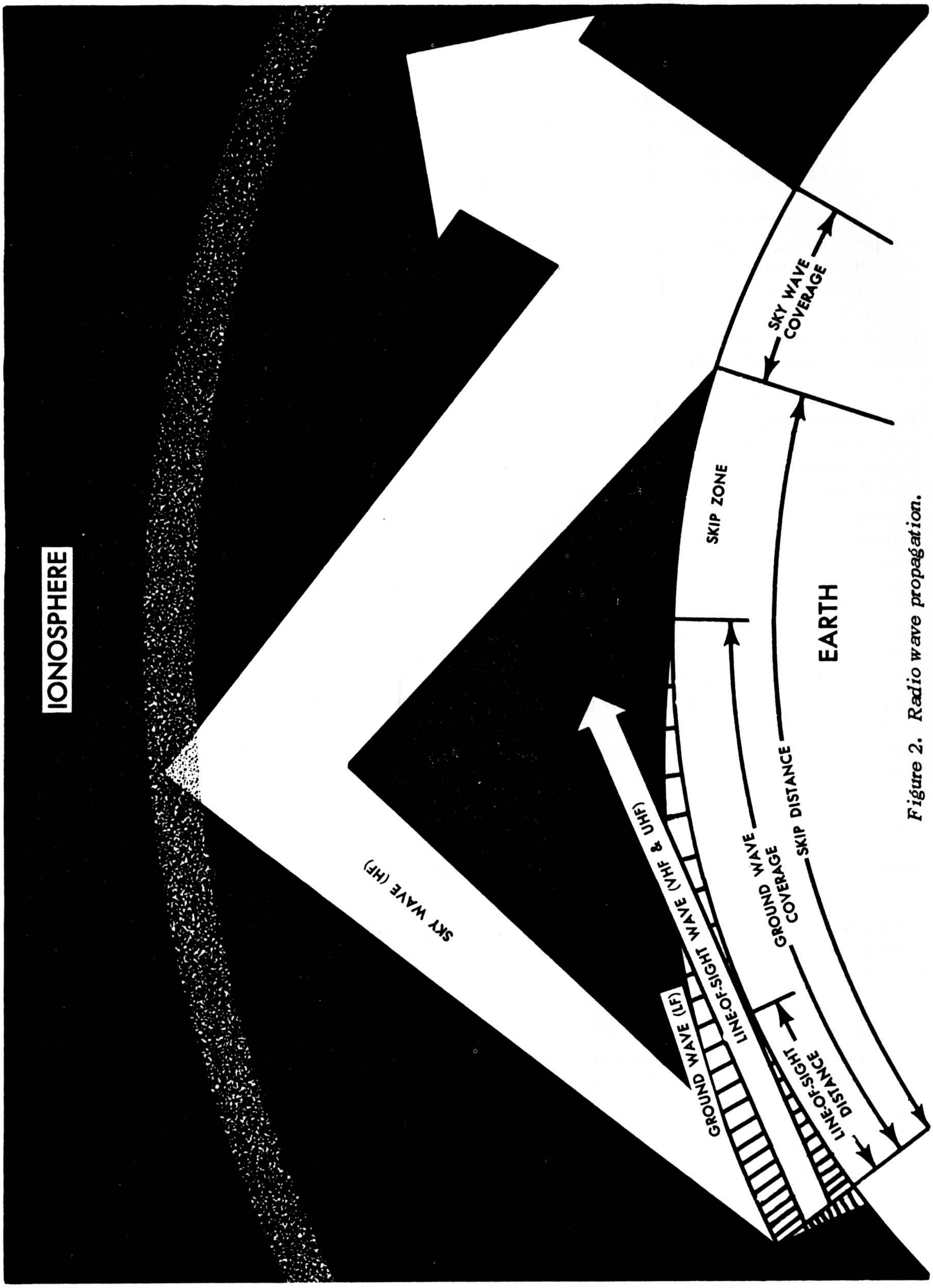
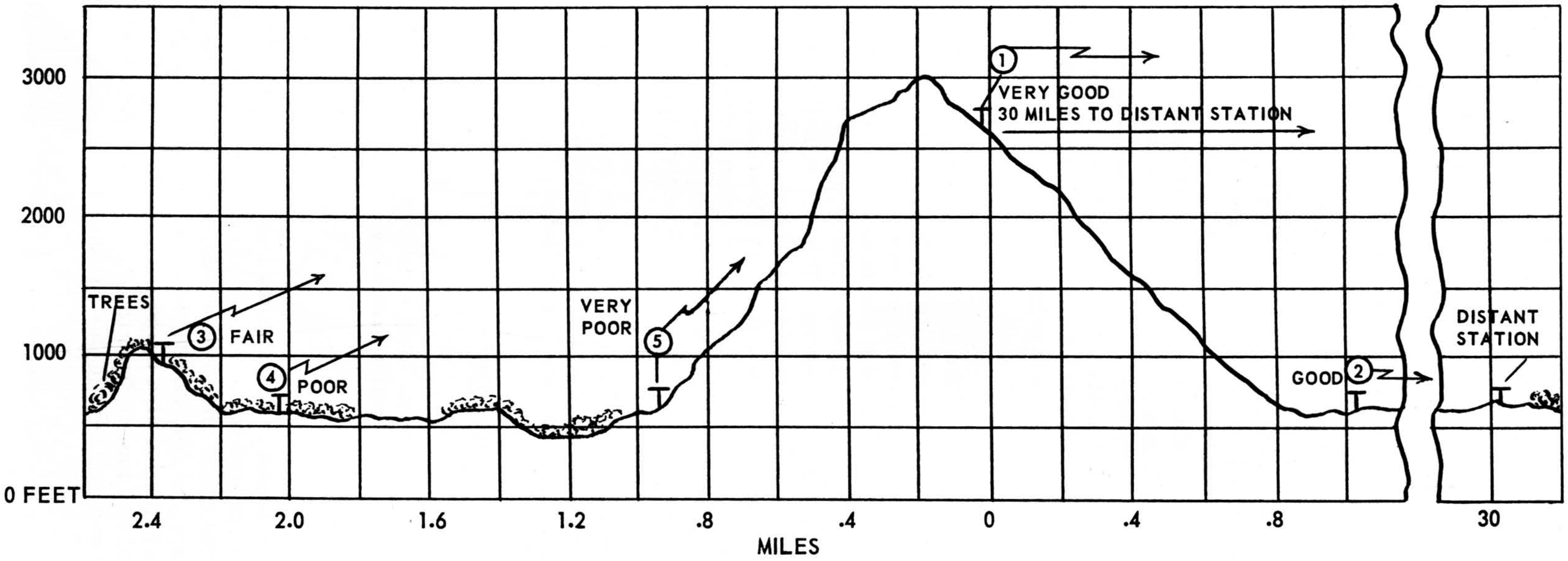


Figure 2. Radio wave propagation.



RELATIVE SIGNAL STRENGTH	
LOCATION	PERCENT RELATIVE TO LOCATION ①
①	100 (Reference)
②	25
③	10
④	2
⑤	1

Figure 3. Location of antenna in hilly areas.

7. THE RADIO TRANSMITTER

The device for sending out radio signals is called a transmitter. The transmitter generates, modulates, and radiates an RF signal. A voice transmitter consists of an RF generator (called an oscillator), a power amplifier for increasing its power to the desired level, a modulator for superimposing the intelligence onto the RF signal, and an antenna for radiating the modulated RF signal. Amplitude modulation is the process of varying the amplitude of a carrier in accordance with the modulating intelligence (fig. 4(c)). Frequency modulation is the process of varying the frequency of an RF carrier wave, in accordance the amplitude and frequency of an audio signal (fig. 4(d)). In both methods, the original RF signal is called a *carrier,* and the frequency of the carrier determines its propagation characteristics. When a carrier is modulated, upper and lower side bands are formed. Since the transmitter signal consists of the carrier and side bands, it covers a band of frequencies. The band width for AM is about 10 kilocycles. The band width for FM is determined by the amount of frequency change with modulation; the band width for military FM radios is 50 to 100 kilocycles. The differences in band width of AM and FM bands indicate that many more AM stations than FM stations can be operated on a given band of frequencies. Amplitude modulation with its narrower band width will put all the power into a narrow band and thus will carry farther than frequency modulation. However, FM transmission has certain advantages. It is relatively free of man-made noise and atmospheric static, and FM transmitters are cheaper to build and use less power from the vehicular battery than do AM transmitters.

8. THE RADIO RECEIVER

a. The radio receiver uses the electromagnetic waves in the air to develop an electrical signal, which is then amplified and demodulated. Radio waves passing an antenna set up minute electrical currents in the antenna which correspond in both frequency and amplitude variation to the radio waves which generated them. These minute currents enter the receiver. A series of amplifiers, each with selective circuits, pick out the band of frequencies corresponding to the signal from a desired station, and amplify it until it becomes fairly strong. This signal still contains the variations corresponding to the intelligence, either in the form of frequency or amplitude modulation. A demodulator is used to remove the intelligence from the carrier. In FM operation the demodulator is called a *discriminator,* and in AM operation the demodulator is called a *detector,* but in either case the result is the discarding of the RF carrier and from it developing the audible signal. The intelligence is then further amplified and made to operate a loud-speaker, earphone, or other device.

b. There are many refinements in both transmitters and receivers that have not been mentioned, since only the essentials to radio communication are intended for discussion here. The refinements are for the purpose of making communication better and more reliable.

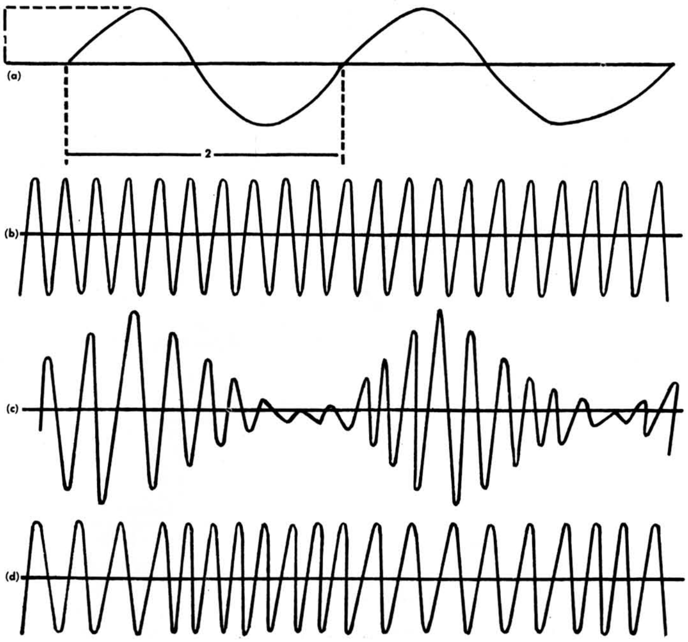
Section IV. FM RADIO EQUIPMENT

9. GENERAL

Most of the radios in armor units are FM voice radio sets. Only voice communication can give the quick-transmission, quick-response type of communication necessary for command and control of highly mobile vehicles.

10. STANDARD SERIES RADIO SETS

Armor's FM sets belong to a family of radios known as the *standard series radio sets.* They are called "standard" because they are issued not only to armor, but also to artillery and infantry units. Most of the armored division standard series radios operate in a band of frequencies known as the *armor band.* (In the case of armored artillery, the frequencies are known as the *artillery band.*) The standard series radios used by armor personnel also operate in a band of frequencies known as the *common band.* All of the armor band and common band radio components are listed in *a* and *b,* above. Each component is explained in detail later in this publication.



(a) Audio-frequency signal.
  1. Amplitude
  2. Cycle
(b) Unmodulated radio-frequency carrier wave.
(c) Amplitude-modulated wave.
(d) Frequency-modulated wave.

Figure 4. Comparison of amplitude and frequency modulation.

a. Armor Band. (20.0 mc to 27.9 mc.)

(1) *Fifteen-mile-range vehicular installed receiver-transmitter.*

(*a*) Common name—Set 1.

(*b*) Official name—RT-66/GRC.

(2) *Receiver, vehicular installed.*

(*a*) Common name—Aux (Auxiliary) Receiver.

(*b*) Official name—R-108/GRC.

(3) *Three to five-mile-range receiver-transmitter, back-pack portable.*

(*a*) Common name—PRC-8 (or Pack Set).

(*b*) Official name—AN/PRC-8.

b. Common Band. (47.0 mc to 58.4 mc.)

(1) *One-mile-range vehicular installed receiver-transmitter.*

(*a*) Common name—Set 2.

(*b*) Official name—RT-70/GRC.

(2) *One-mile range, normally hand carried, receiver-transmitter.*

(*a*) Common name—Handy-Talkie.

(*b*) Official name—AN/PRC-6.

Note. Radio Set AN/PRC-6 can cover only that portion of the common band from 47.0 mc to 55.4 mc. (See fig. 5.)

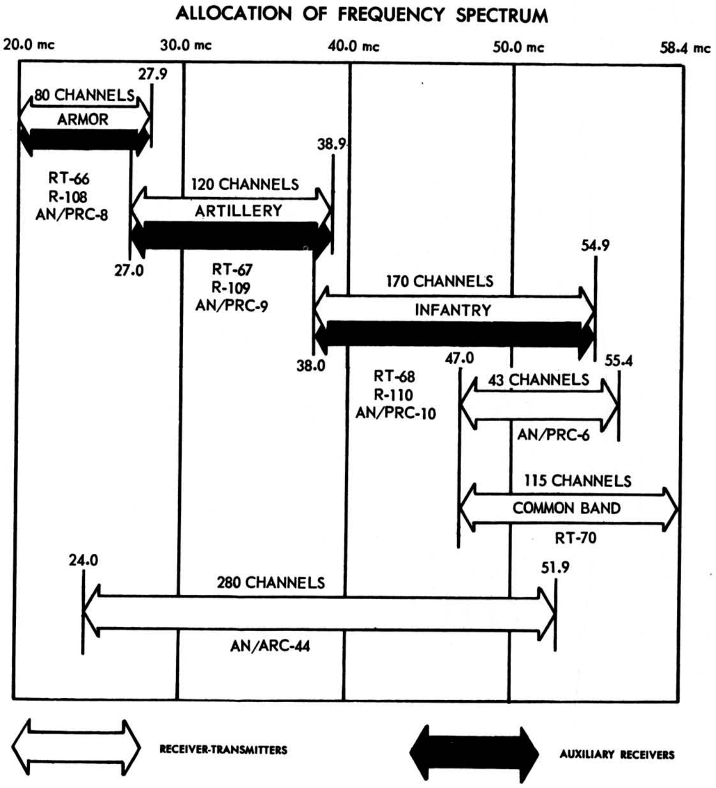


Figure 5. Frequency allocation of FM radio equipment.

c. *Operational facilities.*

Note. Detailed instructions for these radios are provided in this publication under paragraphs devoted to specific sets.

(1) Monitoring.

(2) PUSH-TO-TALK operation from local or remote control stations; and remote, as well as local, control of power to the radios.

(3) Full-duplex telephone circuit between local and remote control units.

(4) Interphone facilities.

(5) Automatic retransmission of received signals.

(6) Full-duplex operation.

(7) Integration with wire equipment.

d. *Installation.* All of the vehicular radios can be installed and operated in tracked and wheeled vehicles with 12- or 24-volt systems. The sets are designed primarily for short-range voice communication within and between armor, artillery, and infantry units.

Note. The following facts apply to the data shown in figure 5.

1. The Set 1's, auxiliary receivers, and pack sets used by armor, artillery, and infantry differ only in that they operate in different frequency bands.
2. As frequency bands change, nomenclatures also change. For example, the portable radio corresponding to armor's AN/PRC-8 is an AN/PRC-9 in artillery, and an AN/PRC-10 in infantry.
3. Armor, artillery, and infantry use identical common band radios.

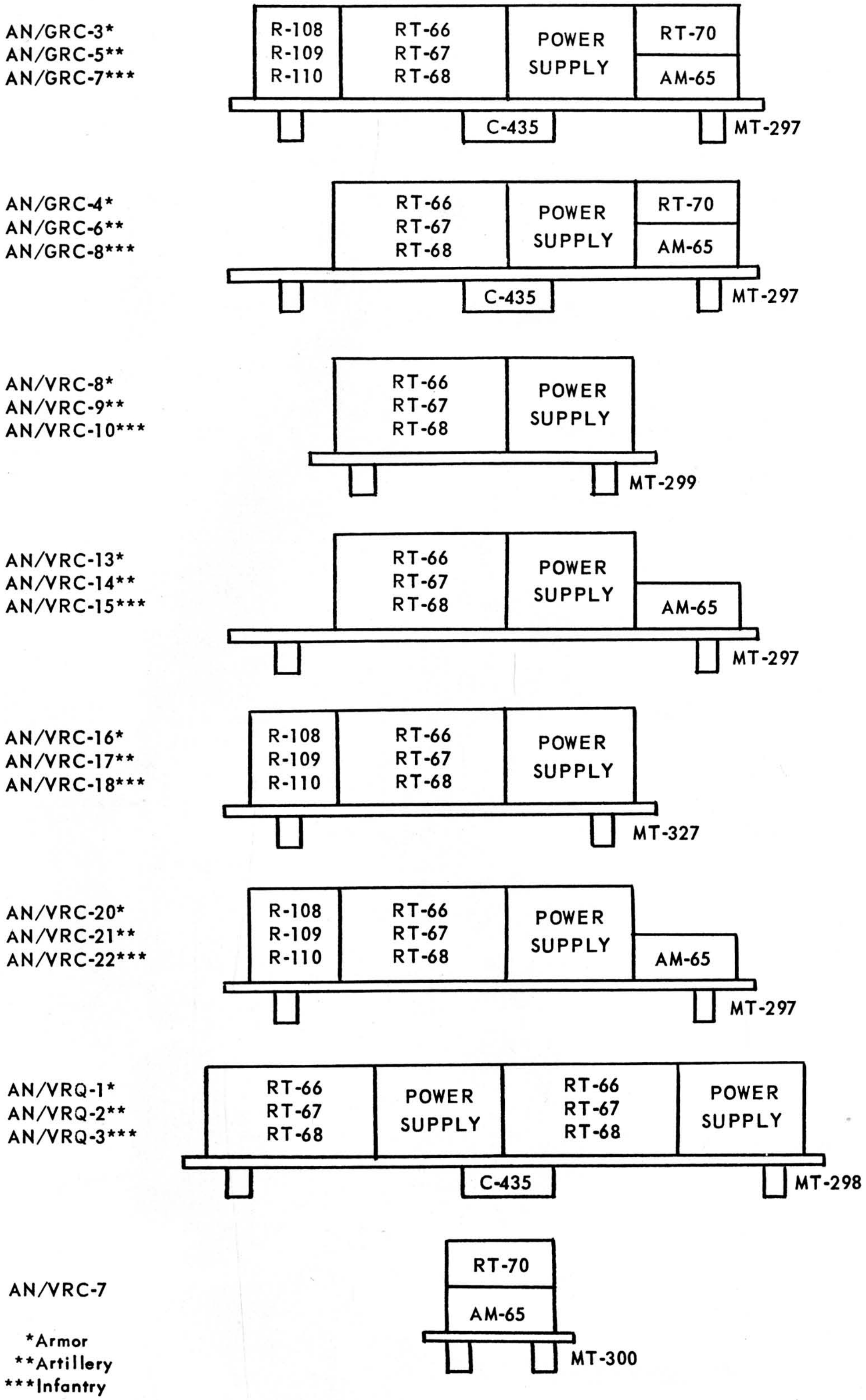


Figure 6. Block diagrams of standard series FM radio sets.

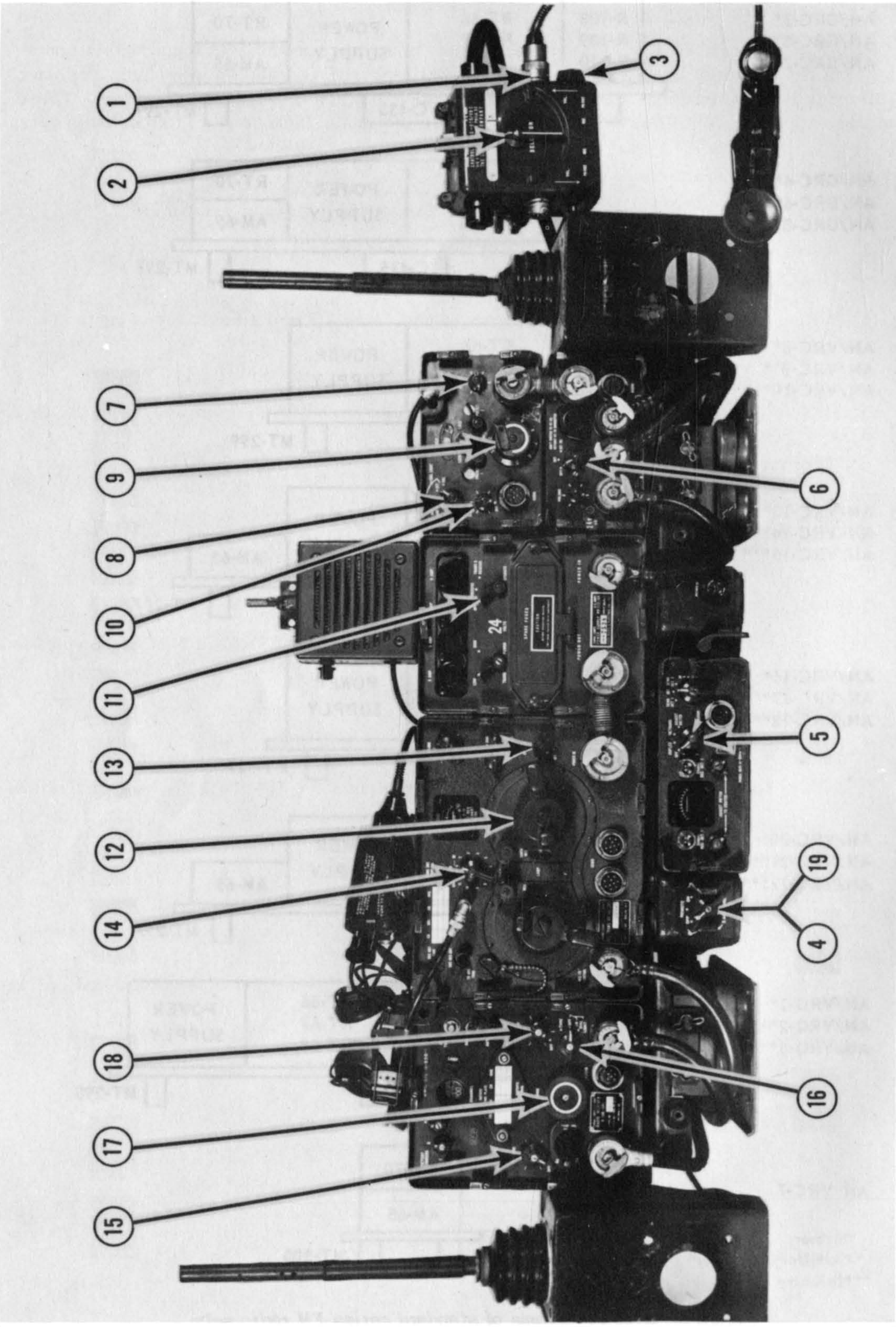


Figure 7. Radio Set AN/GRC-3.

11. RADIO SET AN/GRC-3

Radio Set AN/GRC-3 (fig. 7) is one of the more common command sets found within armor units. This radio consists of a Set 1, a Set 2, an auxiliary receiver, and an interphone amplifier. The following brief instructions list the steps necessary to place this set into operation. These instructions apply to the AN/GRC-5 and -7, and to the individual components in other radio sets.

a. *Operating instructions.*

Note. Step numbers in the following coincide with encircled numbers in figure 7.

(1) Connect audio accessories to Control Box C-375/VRC.

(2) Place the SELECTOR switch on the control box in center position.

(3) Adjust the VOLUME on the control box to mid-point. (Final adjustment is made at discretion of operator.)

(4) Turn the OFF-REMOTE-ON switch on the mount to the ON position.

(5) Ensure that the AUTO switch on the retransmission control (if installed) is in the OFF position.

(6) Turn the OFF-INT-RT-70 switch on the interphone amplifier to the RT-70 position.

(7) Adjust the VOLUME control on Set 2 to maximum.

(8) Calibrate Set 2.

(9) Tune Set 2 to operating frequency.

(10) Adjust SQUELCH on Set 2.

(11) Turn the OPERATE switch on Set 1 power supply to the TRANS & RECEIVE position.

(12) Tune Set 1 to operating frequency.

(13) Adjust SQUELCH on Set 1.

(14) Ensure that the METER switch on Set 1 is in the RF position.

(15) Turn on power on the auxiliary receiver by turning the OFF-VOLUME control clockwise.

(16) Calibrate the auxiliary receiver.

(17) Tune the auxiliary receiver to operating frequency.

(18) Adjust SQUELCH on the auxiliary receiver.

(19) To turn the complete set off, turn the OFF-REMOTE-ON switch on the mount to the OFF position.

> *Note.* For details concerning the tuning of each component, see the individual *operating instructions* for the component in this section.

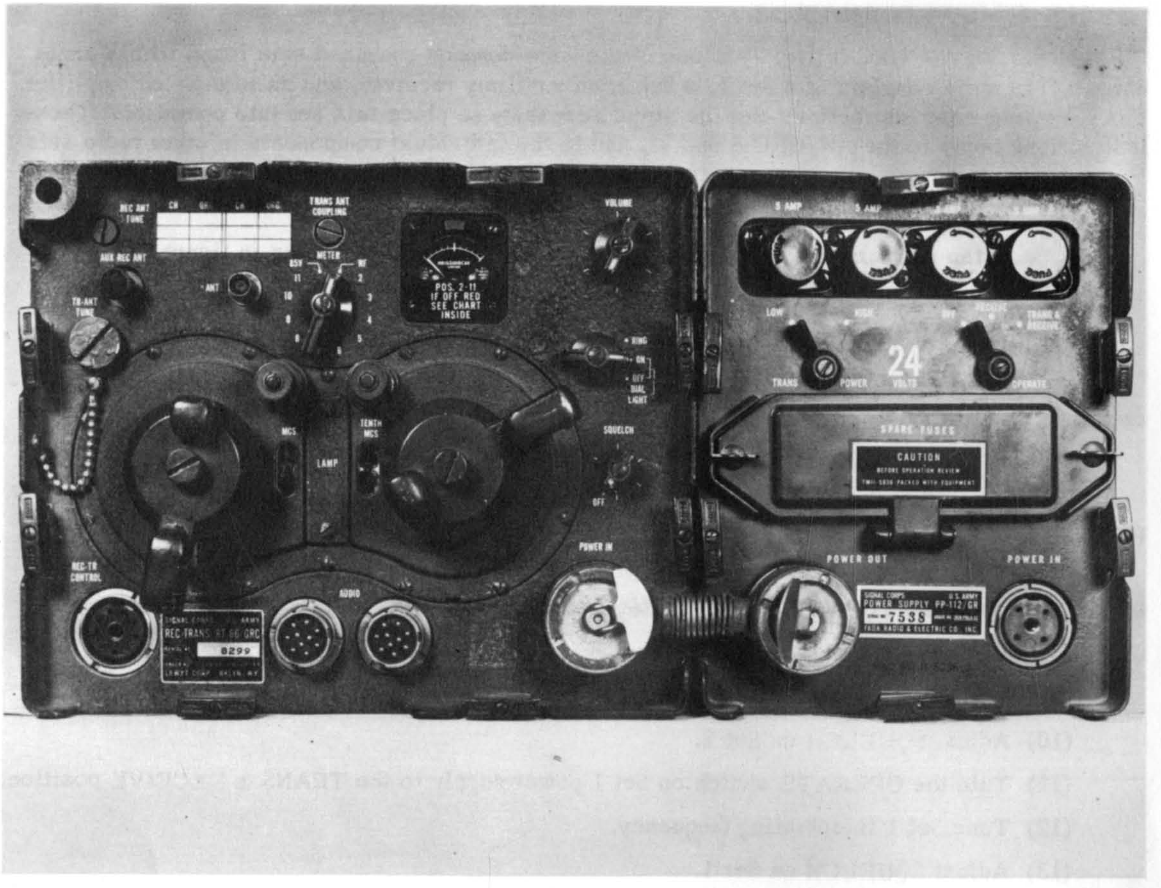


Figure 8. Receiver-Transmitter RT-66/GRC and Power Supply PP-112/GR.

12. RECEIVER-TRANSMITTER RT-66/GRC (SET 1).

a. General. The RT-66/GRC is the FM receiver-transmitter which appears more frequently than any other radio component in the armored division. It is a two-way voice radio which commanders use for command and control of their units, and for contacting logistical and tactical support elements. Its 15-mile range covers the normal distances of deployment of average tactical units. A similar set in artillery is the RT-67, and in infantry, the RT-68. Designed for ease of operation, Set 1 can be tuned in a matter of seconds to any one of the 80 channels in the armor band of frequencies.

b. Characteristics.

(1) *Frequency range.* RT-66, 20.0 to 27.9 mc; RT-67, 27.0 to 38.9 mc; RT-68, 38.0 to 54.9 mc.

(2) *Type of signals.* Voice and 1600-cycle ringing (frequency modulated).

(3) *Type of tuning.* Continuous or detent. The detent mechanism can be released and continuous tuning used when desired.

(4) *Preset frequencies.* Two channels preset by utilizing stop devices.

(5) *Channel spacing.* At 100-kc intervals.

(6) *Range.* Moving, 10 miles; stationary, 15 miles.

(7) *Type of operation.* Push-to-talk.

(8) *Type of control.* Local or remote.

(9) *Power source.* 12- or 24-volt DC or Hand Generator G-8/GRC.

(10) *Power output.* High power, 16 watts; low power, 2 watts.

(11) *Antenna.* Multisection whip.

(12) *Pertinent publication.* TM 11-284.

c. *Operating Instructions.* The tuning of Set 1 involves power, volume, frequency, and squelch adjustments.

(1) *Connection.* Connect a loudspeaker or handset to either of the audio receptacles on the face of Set 1.

(2) *Power.* Turn the OPERATE switch on the PP-112 to TRANS & RECEIVE position.

(3) *Volume.* Turn the VOLUME control on face of Set 1 to maximum clockwise position. (Adjust later to desired listening level, as signals are received.)

(4) *Frequency.* Select the whole-megacycle portion of desired frequency with MCS control, and the tenth-megacycle portion with TENTH MCS control. Small windows located between these controls show the frequency selected.

(5) *Squelch.* Turn the SQUELCH control from the OFF position clockwise to that point where the rushing noise ceases.

Caution. Turn this control no further clockwise than is necessary to eliminate the rushing noise. Extreme clockwise rotation will result in no reception.

Note. The set is now tuned. Press the handset to talk–release it to listen.

d. *Other Operating Hints.*

(1) Use only authorized frequencies. Correct frequencies are found in the SOI Extract.

(2) Use *low power* output as long as good communication can be maintained. (See TRANS POWER switch on PP-112.) Use *high power* output when signals are poor, or when being jammed.

(3) Make SQUELCH adjustment at a time when radio signals are not being received.

13. AUXILIARY RECEIVER R-108/GRC

a. *General.* The Auxiliary Receiver R-108/GRC normally is used in conjunction with Set 1, RT-66/GRC. This receiver gives the user a facility for monitoring an armor band frequency in addition to the frequency tuned on Set 1. It is common practice for a commander to tune Set 1 to his own command net, and monitor his higher-echelon command net on the Auxiliary Receiver. The Auxiliary Receiver is classed R-108 in armor, R-109 in artillery, and R-110 in infantry. The R-108 is part of Radio Sets AN/GRC-3, AN/VRC-16, and AN/VRC-20.

b. *Characteristics.*

(1) *Frequency range.* R-108, 20.0 to 27.9 mc; R-109, 27.0 to 38.9 mc; R-110, 38.0 to 54.9 mc.

(2) *Type of signal.* Voice (frequency modulated).

(3) *Type of tuning.* Continuous, with 3 variable detent selections.

(4) *Channel spacing.* At 100-kc intervals.

(5) *Power source.* 12- or 24-volt DC or external supply.

(6) *Antenna.* Multisection whip.

(7) *Pertinent publication.* TM 11-284.

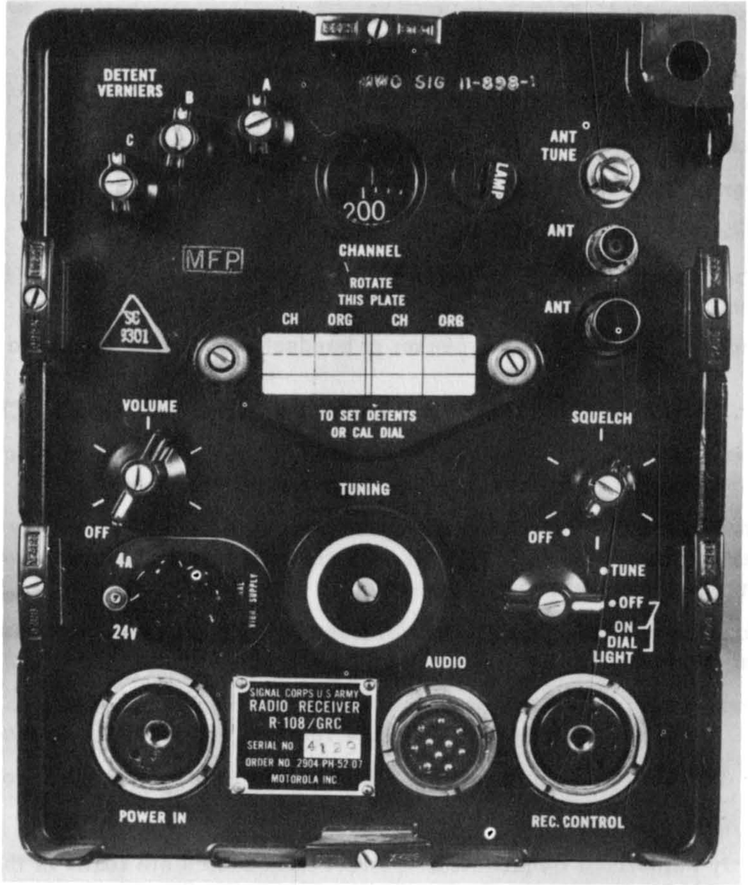


Figure 9. Auxiliary Receiver R-108/GRC.

c. *Operating Procedure.*

(1) *Procedure.* Steps for putting auxiliary receiver on a desired frequency.

Note. As an example, a frequency of 26.0 mc is used in the following.

(*a*) *Power-volume control.* Apply power to the receiver by turning the control in a clockwise direction to maximum position.

(*b*) *Squelch.* Set the SQUELCH control in the OFF position.

(*c*) *Calibration.* Calibration check points are provided for the auxiliary receiver. These points are located at 21.5 mc and 25.8 mc; each is indicated by a red dot on the dial. Select the closer calibration check point to the desired frequency (for example, check point 25.8 mc is used in tuning a frequency of 26.0 mc), and zero-beat the check point frequency.

1. *Zero-beat.* Hold the DIAL LIGHT OFF-ON–TUNE control in the TUNE position, and adjust the TUNING control until the zero-beat indication is obtained. If the red dot lines up with the dial index, the set is calibrated.

2. *Dial correction.* If the red dot does not line up with the dial index, the dial reading can be corrected by turning a dial adjustment screw, which is located behind the diamond-shaped cover plate.

(*d*) *Frequency.* Turn the TUNING control until 260 (26.0 mc) can be read in the dial window.

(*e*) *Squelch.* Adjust the SQUELCH control clockwise to the point where the rushing noise ceases, and no further.

Caution. Further turning may knock out the reception.

(2) *Presetting frequencies.* Provisions are available for detenting any three frequencies. To set up a detented channel, the diamond-shaped plate on the panel face must be loosened. Behind this plate, the user has access to three detent adjustment screws marked DET A, DET B, and DET C. To position detent A when this detent is *not presently in use*:

(*a*) Loosen the DET A adjusting screw one-half turn counterclockwise.

(*b*) Turn the TUNING control throughout its entire range, applying extra pressure at the extremes of rotation, until a flag marked *A* drops into, and remains in, the dial window. This flag must be in the window at the time the following step is accomplished.

(*c*) Properly tune in the desired frequency.

(*d*) Tighten the DET A screw, one-half turn clockwise. The frequency is now detented.

Note. Finer tuning of a detented channel can be accomplished by turning the DETENT VERNIER control corresponding to the identifying letter of the detented channel.

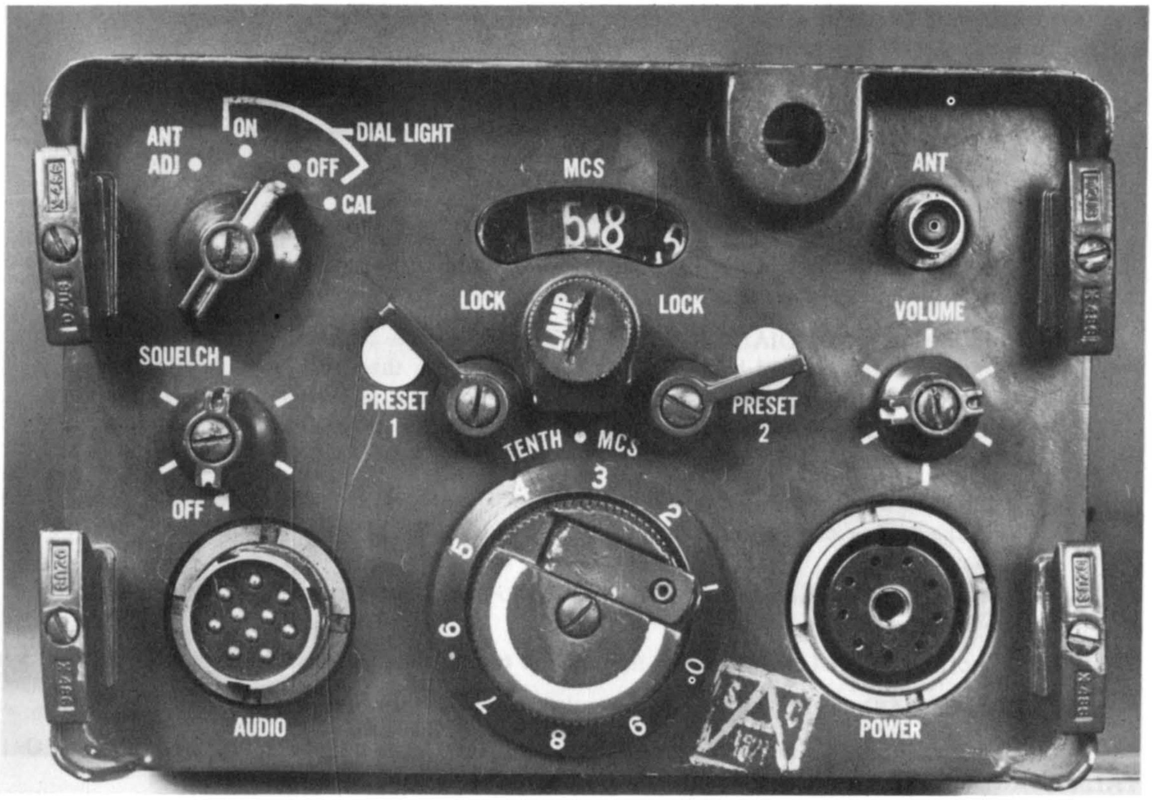


Figure 10. Receiver-Transmitter RT-70/GRC.

14. RECEIVER-TRANSMITTER RT-70/GRC (SET 2)

a. General. A low-power FM receiver-transmitter for short-range communication is a necessary part of the radio equipment of the ground forces. The armored division uses this compact vehicular radio for many purposes, chief of which is for two-way communication between tank crews and armored infantry squads (tank-infantry teams). The RT-70/GRC is commonly referred to as the "Common band set," or when it is a part of Radio Sets AN/GRC-3 through -8, it is referred to as "Set 2." It is the receiver-transmitter of Radio Set AN/VRC-7.

b. Characteristics.

(1) *Frequency range.* 47.0 to 58.4 mc.

(2) *Type of signal.* Voice (frequency modulated).

(3) *Type of tuning.* Continuous.

(4) *Preset channels.* Two preset by utilizing the two lock preset levers.

(5) *Channel spacing.* At 100-kc intervals.

(6) *Range (planning).* 1 mile.

(7) *Type of operation.* Push-to-talk.

(8) *Type of control.* Local or remote.

(9) *Power source.* 12- or 24-volt DC.

(10) *Power output.* 500 milliwatts.

(11) *Antenna.* Multisection whip.

(12) *Pertinent publication.* TM 11-284.

c. Operating Procedure, Set 2. Connect an audio accessory to the AUDIO receptacle on Set 2. Turn the SQUELCH control to the OFF position.

(1) *Power.* Turn the OFF-INT-RT-70 switch to the RT-70 position.

(2) *Volume.* Turn the VOLUME control on Set 2 clockwise to maximum.

(3) *Frequency.*

Note. Set 2 must be calibrated each time the frequency is changed.

(*a*) Turn the tuning control until the whole-megacycle point nearest the desired frequency shows in the center of the MCS dial window.

(*b*) Hold the ANT ADJ DIAL LIGHT ON-OFF-CAL switch in the CAL (calibrate) position. Turn the tuning control back and forth until you hear the audible calibration signal. Adjust the tuning control until the pitch of the audible signal goes down to the zero-beat point. The zero-beat is an indication that the receiver-transmitter is tuned to the whole-megacycle point indicated on the MCS dial.

(*c*) If the zero on the tuning control is not exactly opposite the white index dot on the panel, hold the tuning control and adjust its outer ring until the zero and the white dot are in line.

(*d*) Check the calibration to ensure that the zero-beat occurs when the zero lines up with the white dot.

(*e*) Select the desired frequency by turning the tuning control until the frequency is indicated.

(4) *Squelch.* Adjust the SQUELCH control to the point of noise suppression.

(5) *Transmission.* To transmit, press the PUSH-TO-TALK switch; release the PUSH-TO-TALK switch to listen.

d. Presetting Procedure, Set 2.

(1) *Initial setting.*

(*a*) Release the two PRESET levers by turning them to the horizontal position.

(*b*) Turn the tuning control over its entire range (from one end to the other) before selecting the desired frequency. Calibrate and tune the receiver-transmitter to one of the desired frequencies.

(c) Turn one of the PRESET levers to the vertical (LOCK) position. Mark the preset frequency on the label next to the lever.

(*d*) Calibrate and tune the receiver-transmitter to the second desired frequency.

(*e*) Turn the second PRESET lever to the vertical (LOCK) position and mark the preset frequency on the label next to the lever. Unless the preset frequencies are labeled or recorded, it is impossible to distinguish which lever controls which detented frequency.

(2) *Changing preset frequencies.*

(*a*) Turn the TUNING control until the original preset frequency is engaged.

(*b*) Remove the detent by turning the associated lever (PRESET 1 or PRESET 2 as indicated on the marker) to the horizontal position.

Note. It is not necessary to turn the tuning control through the entire sweep of the dial if the PRESET lever is unlocked while the original preset channel is engaged.

(*c*) Calibrate and tune the receiver-transmitter to the new frequency and return the PRESET lever to the LOCK position. This presets the new channel.

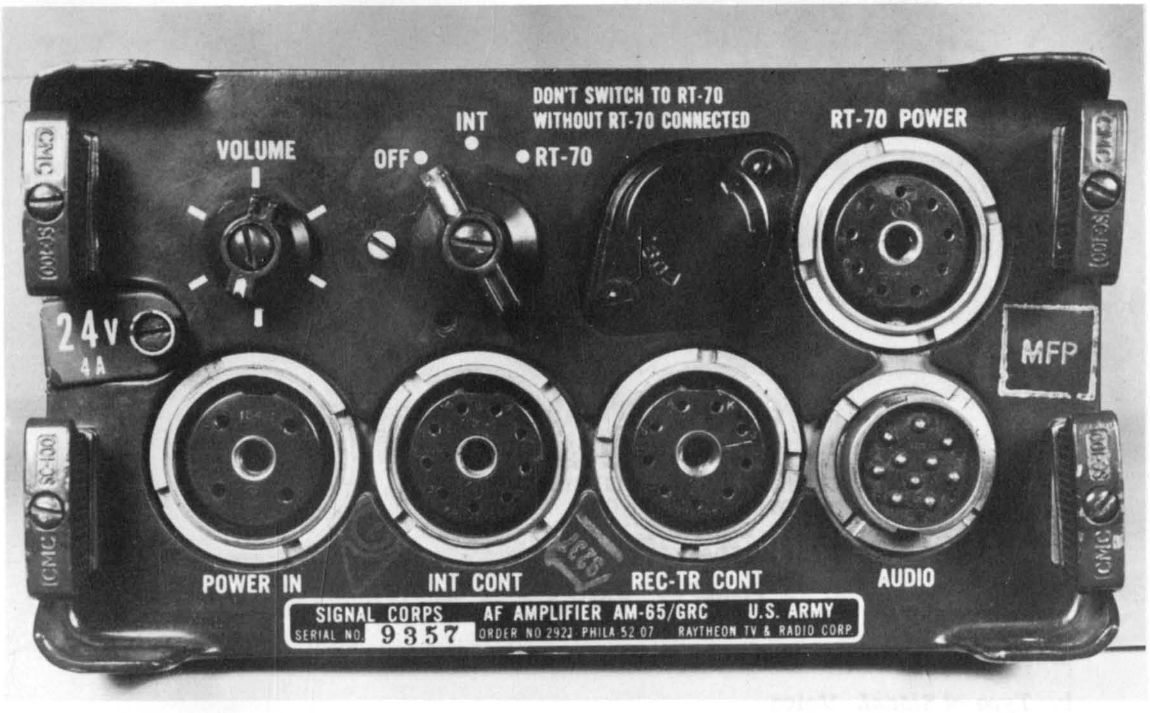


Figure 11. Amplifier AM-65/GRC.

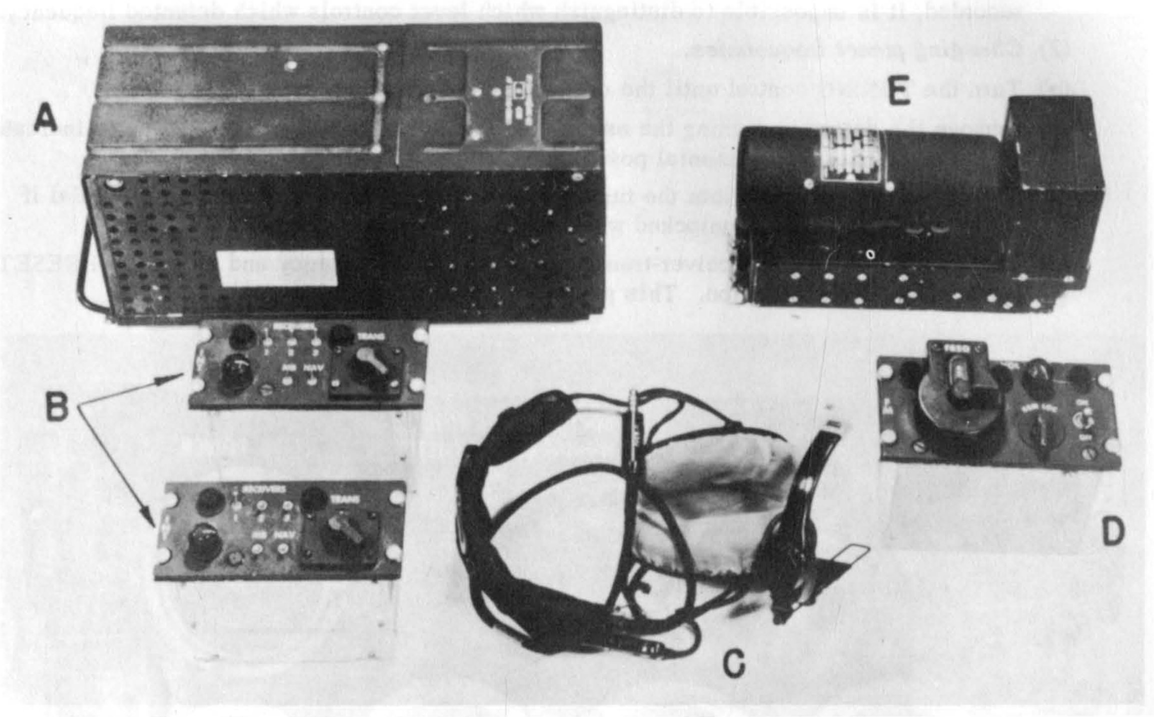
15. AF AMPLIFIER AM-65/GRC

This unit (fig. 11) is a three-channel electronic mixer and AF amplifier. It is commonly referred to as the interphone amplifier because it provides interphone communication in vehicles. It also serves as a monitor amplifier for the two receiver-transmitters and the auxiliary receiver. There are three different combinations of signals. Channel 1 monitors the auxiliary receiver, Set 1, and the interphone system. Channel 2 monitors the auxiliary receiver, Set 1, Set 2, and the interphone system. Channel 3 monitors Set 2 and the interphone system. A switch on Control Box C-375/VRC selects any of the three channels. Control Group AN/GRA-6 and Control C-435/GRC (retransmission unit) receive Channel 2 only. The interphone amplifier contains the power supply which supplies power to the amplifier and to Receiver-Transmitter RT-70/GRC.

Note: For additional information, refer to TM 11-5039.

16. RADIO SET AN/ARC-44

Radio Set AN/ARC-44 (fig. 12) is an FM aircraft radio set designed to provide voice communication between aircraft and army tactical field radio equipment of portable, vehicular, and ground types organic to armor, artillery, and infantry.



COMPONENTS OF RADIO SET AN/ARC-44

A. RECEIVER-TRANSMITTER
B. PANELS, SIGNAL DISTRIBUTION
C. HEADSET-MICROPHONE
D. PANEL CONTROL
E. DYNAMOTOR

Figure 12. Radio Set AN/ARC-44.

a. *Frequency Range.* 24.0 to 51.9 mc.

b. *Type of Signal.* Voice.

c. *Control.* Crystal.

d. *Modulation.* FM.

e. *Power Output.* 8 watts.

f. *Principal Type of Service.* Aircraft.

g. *Channel Spacing.* At 100-kc intervals.

h. *Number of Channels.* 280.

i. *Weight.* 34 pounds (installed in Army aircraft).

j. *Pertinent Publication.* TM 11-517.

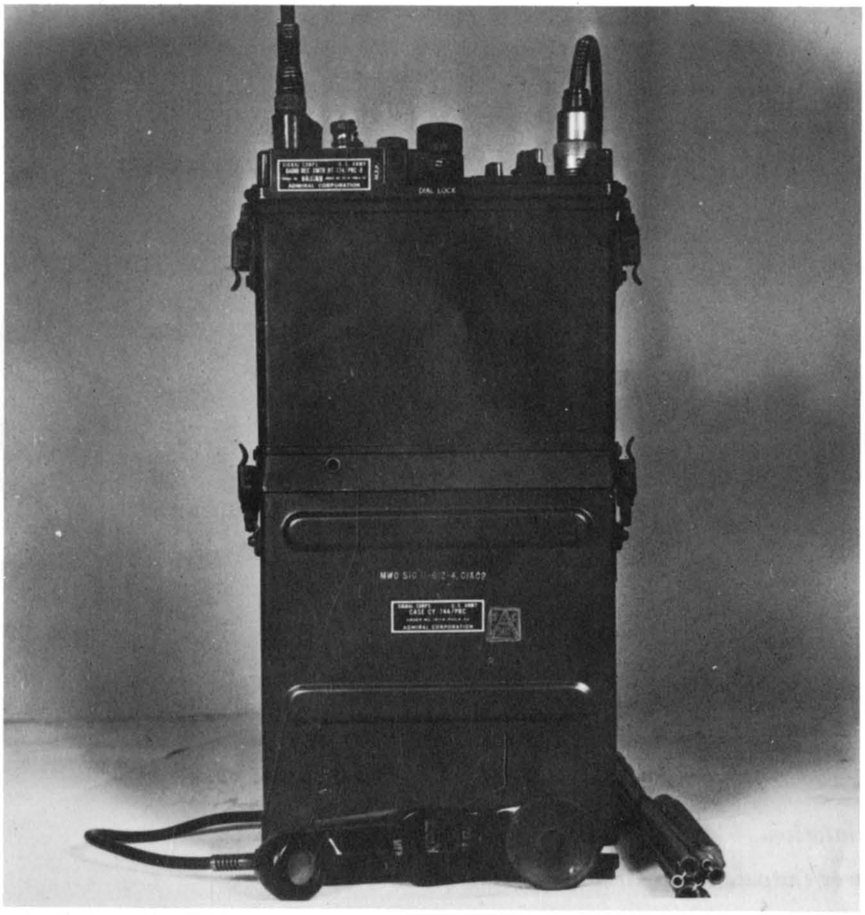


Figure 13. Radio Set AN/PRC-8 (profile view).

17. RADIO SETS AN/PRC-8, -9, and -10

Radio Sets AN/PRC-8, -9, and -10 (fig. 13) are frequency-modulated sets intended to provide portable communication for armor, artillery, and infantry units respectively. The specific frequency of each set and of other equipment with which the sets can communicate is indicated in the frequency chart (fig. 5). Radio sets AN/PRC-8A, -9A, and -10A are identical to the AN/PRC-8, -9, and -10 respectively, the major exception being that the "A" models have side-tone facilities, different calibration points, and a putt-putt sound is heard when tubes are warming up on the transmit position.

a. Frequency range.

(1) AN/PRC-8: 20.0 to 27.9 mc, 80 channels.

(2) AN/PRC-9: 27.0 to 38.9 mc, 120 channels.

(3) AN/PRC-10: 38.0 to 54.9 mc, 170 channels.

b. Range in miles.

(1) Short antenna (36-inch steel tape)–3 miles.

(2) Long antenna (108-inch whip)–5 miles.

c. Type Signal. Voice.

d. Channel Spacing. 100-kc intervals.

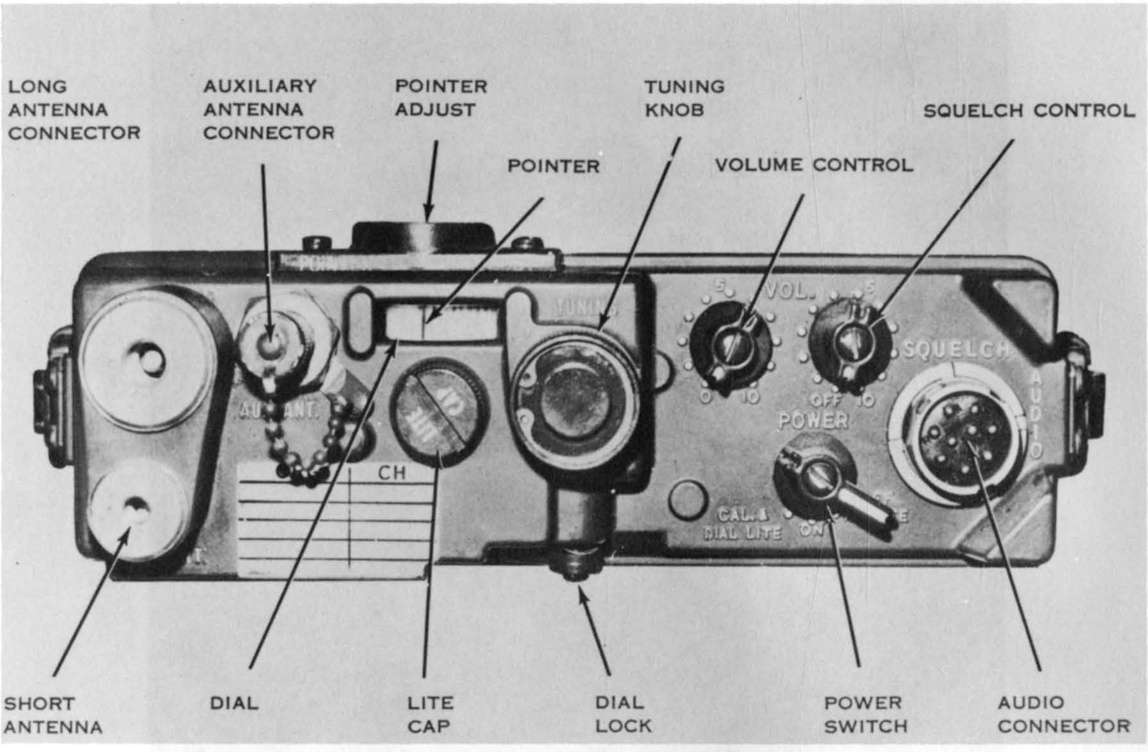


Figure 14. Radio Set AN/PRC-8 (panel view).

e. *Modulation.* FM.

f. *Power Output.* Approximately 1 watt.

g. *Power Source.* Dry Battery BA-279/U; Artic Battery BA-2279; Power Supply AM/598 (operates on 24 volts only) for vehicular installations.

h. *Weight.* 26 pounds including battery.

i. *Pertinent Publication.* TM 11-612.

j. *Operating Procedure.*

(1) *Power.* Turn the OFF-REMOTE-ON-CAL & DIAL LIGHT control to the ON position.

(2) *Volume.* Turn the VOL control to the maximum clockwise position. Readjust later as desired.

(3) *Squelch.* Turn the SQUELCH control to the OFF position.

(4) *Frequency.*

Note. To tune to a frequency (for example, 26.3 mc), the accuracy of the dial reading must first be checked.

(*a*) Turn the TUNING knob until the whole-megacycle point closest to the operating frequency appears in the center of the dial. (The nearest whole megacycle point to 26.3 mc is 26.0 mc.)

(*b*) Hold the OFF-REMOTE-ON-CAL & DIAL LIGHT control in the CAL & DIAL LIGHT position and, while listening, turn the TUNING knob back and forth across the whole megacycle until zero-beat is obtained.

(*c*) Turn the POINTER ADJUST knob until the pointer lines up exactly with the whole megacycle. This corrects the dial reading.

(*d*) Turn the TUNING knob until the operating frequency is indicated by the pointer in the dial window. For the example given (26.3 mc) this is three small lines beyond the 26.0 reading.

(5) *Squelch.* Turn the SQUELCH control clockwise to the point where the rushing noise ceases.

(6) *Operation.* Press handset switch to talk; release to listen.

Note. Radio Set AN/PRC-8A is tuned in a similar manner; however, on the model -8A, calibration check points are located at *four* red lines, evenly spaced on the dial. To check the calibration, the user selects the closest red line, rather than the closest whole-megacycle point.

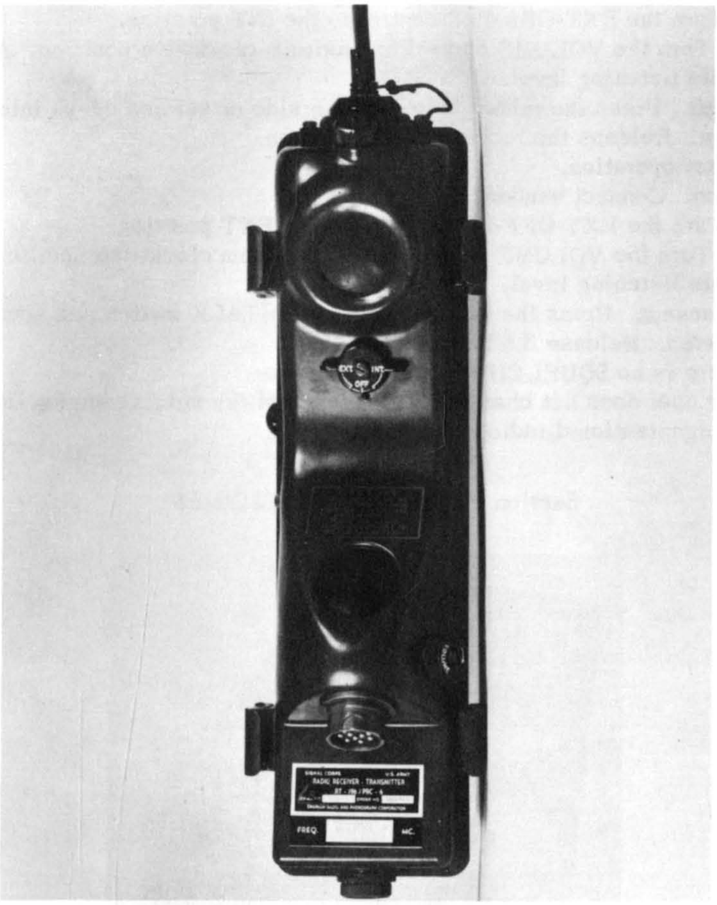


Figure 15. Radio Set AN/PRC-6.

18. RADIO SET AN/PRC-6

Radio Set AN/PRC-6 (fig. 15) is a miniature, low-power, battery-operated, radio receiver and transmitter designed for communication over short distances. Highly portable, it is intended primarily as a handy-talkie for foot combat troops. No special skill is required to operate it. The total weight of the equipment including the battery is approximately 6½ pounds. It is used by armor, artillery, and infantry units.

a. Frequency Range. 47.0 to 55.4 mc.

b. Range in Miles. 1.

c. Type Signal. Voice.

d. *Control.* Crystal.

e. *Modulation.* FM.

f. *Power Output.* 0.25 watt.

g. *Principal Type of Service.* Dismounted individual.

h. *Channel Spacing.* At 200-kc intervals.

i. *Number of Channels.* 43.

j. *Power Source.* Dry Battery BA-270/U; Artic Battery BA-2270.

k. *Weight.* 6.5 pounds.

l. *Pertinent Publication.* TM 11-296.

m. *Operating Procedures.*

(1) If held in the hand of the user.

(*a*) *Power.* Turn the EXT-OFF-INT control to the INT position.

(*b*) *Volume.* Turn the VOLUME control to maximum clockwise position. Adjust later to comfortable listening level.

(*c*) *To transmit.* Press the rubber button on the side of set and speak into transmitter.

(*d*) *To receive.* Release the rubber button to listen.

(2) For handset operation.

(*a*) *Connection.* Connect handset.

(*b*) *Power.* Turn the EXT-OFF-INT control to the EXT position.

(*c*) *Volume.* Turn the VOLUME control to the maximum clockwise position. Adjust later to comfortable listening level.

(*d*) *How to transmit.* Press the handset PRESS-TO-TALK switch and speak into handset.

(*e*) *How to listen.* Release the handset to listen.

Note. 1. There is no SQUELCH control on the set.

2. The user does not change the frequency of the set. Changing frequencies is a duty of organizational radio mechanics.

Section V. RADIO ACCESSORIES

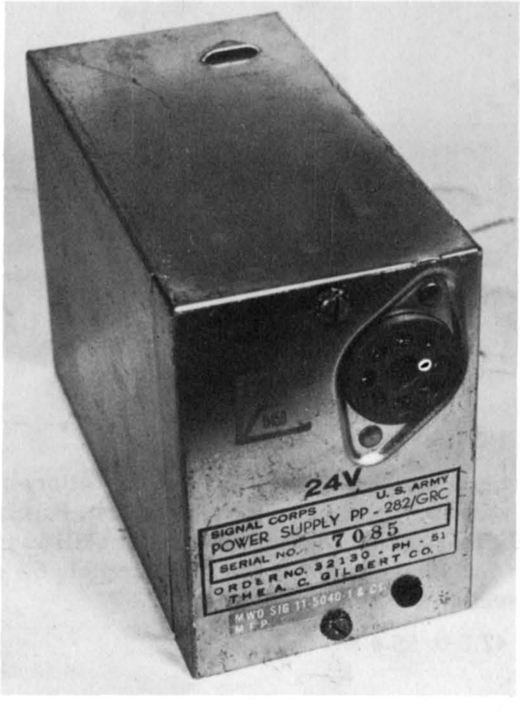


Figure 16. Power Supply PP-282/GRC.

19. POWER SUPPLIES PP-281/GRC AND PP-282/GRC

Power Supplies PP-281 and PP-282 are used with 12- and 24-volt installations respectively. A unit is required to supply power to the auxiliary receiver, and a second unit is required to supply power for the interphone amplifier. The unit in the amplifier is also used to supply voltages for Receiver-Transmitter RT-70/GRC (Set 2). The units are vibrator-type power supplies which plug into compartments on the auxiliary receiver and interphone amplifier chassis and are similar in appearance and general characteristics. Refer to figure 16.

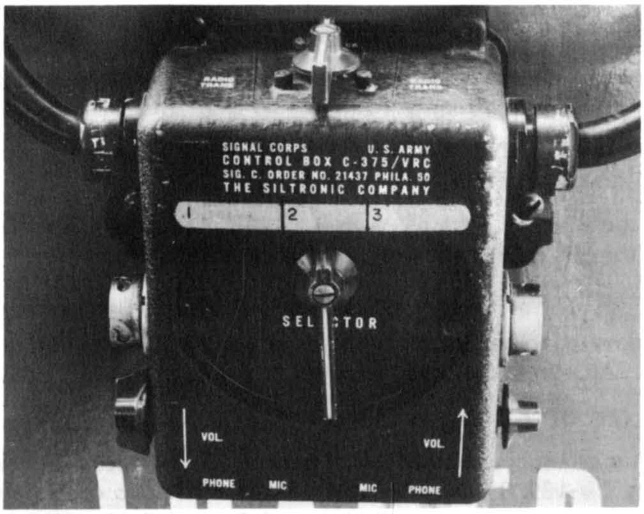


Figure 17. Control Box C-375/VRC.

20. CONTROL BOX C-375/VRC

a. General. The control box permits operation of the radio sets from crew positions in a vehicle. Handset H-33/PT or Chest Set Group AN/GSA-6 plug into the control box. The basic adjustments of power, frequency, and squelch must be made at the radio set. Once this is done, a selector switch on the control box permits selection of any of the three monitoring outputs of the interphone amplifier and controls transmission over Set 1 or Set 2. There is a volume control on the control box so that each crew member can adjust his own volume.

b. Operating Procedures for use with Radio Set AN/GRC-3.

(1) *How to transmit.*

(a) *To transmit on Set 1.* Turn the SELECTOR switch to the counterclockwise position. Hold or lock the RADIO TRANS switch off center. Press the RADIO button on the chest set.

(b) *To talk by interphone to other crew members.* Press the INTERPHONE button on the chest set and speak into the microphone. (The controls on the control box may be in *any* position.)

(c) *To transmit on Set 2.* Turn the SELECTOR switch to the clockwise position. Hold or lock the RADIO TRANS switch off center. Press the RADIO button on the chest set.

(2) *How to receive.*

Note. The position of the RADIO TRANS switch on the control box has no effect on any type of *reception.* For any reception, the VOLUME control on the user's side of his control box must be rotated clockwise.

(a) *Interphone reception from fellow crewman.* Reception from a fellow crewman is possible with the SELECTOR switch in any position.

(*b*) *To receive Set 1.* Turn the SELECTOR switch to the *counterclockwise* or *center* position. The auxiliary receiver will also be received in these positions.

(*c*) *To receive Set 2.* Turn the SELECTOR switch to the *clockwise* or *center* position. The VOLUME control on Set 2 must have some clockwise rotation.

(*d*) *To receive all radio components plus interphone.* Turn the SELECTOR switch to the *center* position. The VOLUME control on Set 2 must have some clockwise rotation.

(3) *Crew information.*

(*a*) Any crew member can transmit over either Set 1 or Set 2.

(*b*) One crew member can be transmitting over Set 1, and at the same time another crew member, from a different control box, may be transmitting over Set 2.

(*c*) A crew member using the interphone will not interfere with any *radio* transmission being made at the time by another crew member.

(*d*) Interphone operation is possible with the SELECTOR switch in any position. This means that the SELECTOR switch is strictly a radio "selector."

(*e*) In order to use the control box, the interphone amplifier must be turned on.

(*f*) A recently developed helmet designed especially for tankers contains a headset and microphone. An electrical cord connects this helmet directly to Control Box C-375/VRC.

21. CONTROL GROUP AN/GRA-6

a. General. This group consists of Local Control C-434/GRC, Remote Control C-433/GRC, Handset H-33/PT, Bag CW-189/GR, and Speaker LS-166. The two controls may be used independently of the radio set as field telephones. With Local Control C-434/GRC installed in the mounting and connected to Remote Control C-433/GRC by approximately 2 miles of wire, remote operation of the radio set is possible. From the remote control, the user may control power to the radio set and transmit over either Set 1 or Set 2, but not both. Or, the user may leave the power turned on at the radio set and transmit over either Set 1 or Set 2 from the remote point. Telephone communication is provided between local and remote controls and the radio may be operated from the local control. This control group may be used with any standard series set. A cord from the Interconnecting Box J654/G (shown on top of the remote control unit, fig. 18) can be connected to the audio receptable on the Remote Control C-433/GRC. A loud-speaker can be connected to one of the receptacles on the interconnecting box and a handset to the other. This gives the remote user loud-speaker reception and handset transmission capabilities if desired.

b. Operating Procedures, Control Group AN/GRA-6.

(1) *Telephone operation.* To use the local and remote control units as field telephones, do the following:

(*a*) Connect an audio accessory to each of their audio receptacles.

(*b*) Connect the necessary length of field wire between their wire binding posts.

(*c*) Place the remote control unit SELECTOR switch in the TEL position.

(*d*) Place the local control unit REMOTE switch in the TEL ONLY position.

(*e*) To signal, turn the hand generator.

(*f*) To talk, press the PUSH-TO-TALK switch, and speak into the microphone. The user does not have to release to listen to the distant party.

Note. 1. The above, control settings would apply when either the local or remote control unit is connected by wire to any field telephone or switchboard.

2. A *bell* or *lamp* signals the user when the distant party turns his (the distant) hand generator. A BELL-LAMP switch located inside the local and remote control units select the audible (bell) or the visual (lamp) signal, as desired by the user.

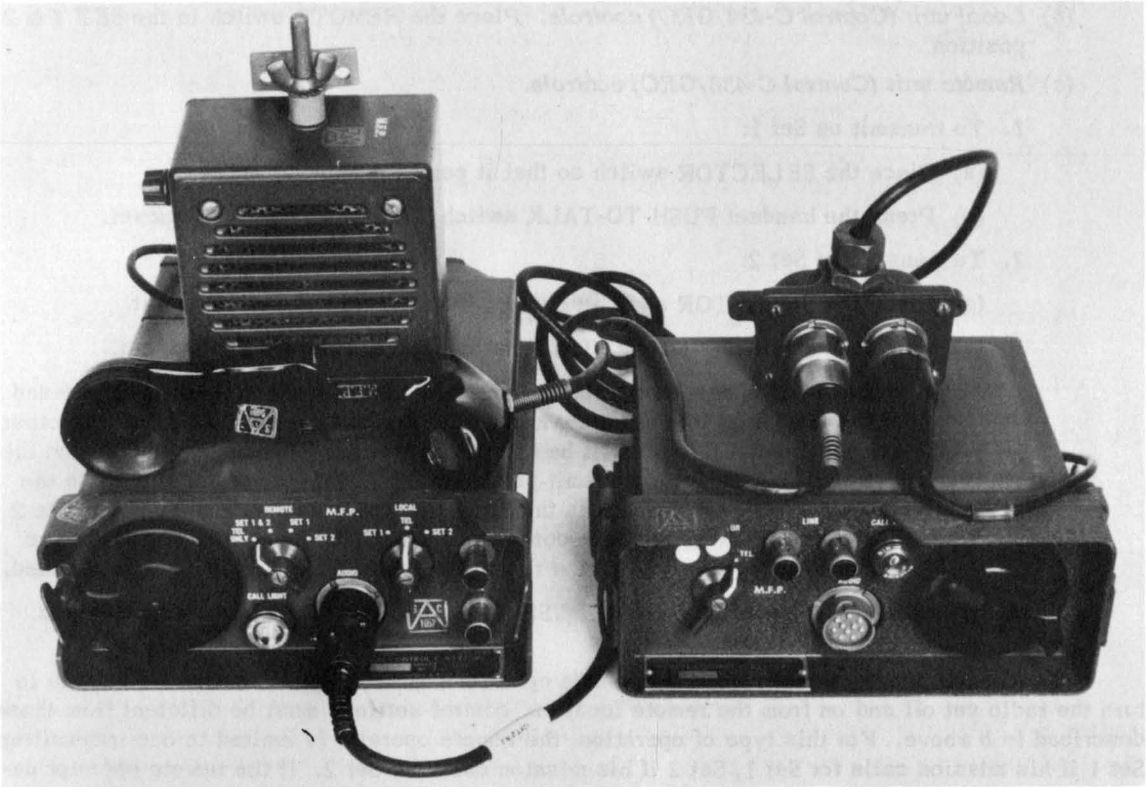


Figure 18. Control Group AN/GRA-6 (less bag).

(2) *Local radio operation from the local unit.* When set up for remote radio control, it is desirable to have a local attendant physically present at the radio site. The local radio attendant desiring to use the radio set would place the REMOTE switch in the SET 1 & 2 position and act as follows.

(*a*) To transmit on Set 1:

1. Hold the LOCAL switch in the counterclockwise position.

2. While holding this position, press the PUSH-TO-TALK switch and speak into the microphone.

(*b*) To transmit on Set 2:

1. Hold the LOCAL switch in the clockwise position.

2. While holding this position, press the PUSH-TO-TALK switch and speak into the microphone.

(*c*) To listen: Release the LOCAL switch and the PUSH-TO-TALK switch.

c. *Remote Operation of Radio Set AN/GRC-3.* For the following operation, the local control unit (Control C-434/GRC) must be installed in the mounting base, and field wire must lead to the remote control unit (Control C-433/GRC).

(1) *Obtaining access to transmitters.* When the remote operator must have access to either of his transmitters (Set 1 and 2) the following must be accomplished.

(*a*) *OFF-REMOTE-ON control on the mounting base.* Move to the REMOTE position or the ON position.

(*b*) *Local unit (Control C-434/GRC) controls.* Place the REMOTE switch in the *SET 1 & 2* position.

(c) *Remote unit (Control C-433/GRC) controls.*

1. To transmit on Set 1:

(a) Place the SELECTOR switch so that it points to the left dot.

(b) Press the handset PUSH-TO-TALK switch, and speak into the handset.

2. To transmit on Set 2:

(a) Place the SELECTOR switch so that it points to the dot on the right.

(b) Press the handset PUSH-TO-TALK switch and speak into the handset.

Note. If that particular wire which terminates at the terminal marked L1 at one end of the field wire line *does not* happen to terminate at terminal L1 at the other component, the left dot will be the Set 2 transmit position, and the dot on the right will be the Set 1 transmit position. The remote operator will write the number *1* in that dot which is the Set 1 transmit position, and he will write 2 in the other dot. If the wire conductors are identified in this manner before the remote operator leaves the radio site, possible confusion can be avoided.

3. To receive: Release the handset PUSH-TO-TALK switch. All radio components will be received.

(2) *Remote power control.* When the remote operator's mission demands that he be able to turn the radio set off and on from the remote location, control settings must be different from those described in *b* above. For this type of operation, the remote operator is limited to one transmitter; Set 1 if his mission calls for Set 1, Set 2 if his mission calls for Set 2. If the remote operator desires to be able to turn the radio set off and on, and selects Set 1 for periodic transmissions, the following control settings apply.

(*a*) *OFF-REMOTE-ON control on the mounting base.* Move to the REMOTE position.

(*b*) *Local unit controls.* Place the REMOTE switch in the SET 1 position.

(c) *Remote unit controls.*

1. To turn the entire radio set ON:

(a) Place the SELECTOR switch so that it points toward the left dot.

(*b*) Press the handset momentarily. This turns power on to the mounting base of the radio set. All active components on the mounting base are now turned on.

2. To transmit: After allowing a few seconds for the radio set to warm up, press the handset PUSH-TO-TALK switch and speak into handset. This will cause transmission on Set 1.

3. To receive: Release the handset. This will permit the operator to hear not only Set 1, but all radio components which have their individual power switches ON.

4. To turn the radio set OFF:

(a) Set the SELECTOR switch so that it points to the dot on the right.

(b) Press the handset momentarily. This turns the entire radio OFF.

Notes. 1. If that particular wire which terminates at terminal L1 at one end of the field wire line *does not* terminate at terminal L1 at the other component, the dot on the right will be the *power on* position, and the left dot will be the *power off* position.

2. If Set 2 transmission (and remote power control) is desired, the operation will be as described above for Set 1; however, the REMOTE switch on the local control unit must be in the SET 2 position.

d. Radio-Wire Integration. Radio-wire integration may be achieved by use of Control Group AN/GRA-6 and other equipment organic to armor battalions. Any wire system which employs Switchboards SB-22/PT or SB-993/GT can be integrated into the unit's radio nets by doing the following:

(1) *Preparation.* (Refer to fig. 19.)

(*a*) Locate a radio such as an AN/GRC-3 or -4 at a favorable site in the command post area.

(*b*) Install local control unit at (or in the mounting base of) the radio.

(*c*) Place the remote control unit at the switchboard site—on top of the switchboard, or within an arm's reach of it.

(*d*) Install field wire between the local and remote units (as previously described for remote radio control). Check out the remote unit for remote operation of the radio before proceeding to the next step.

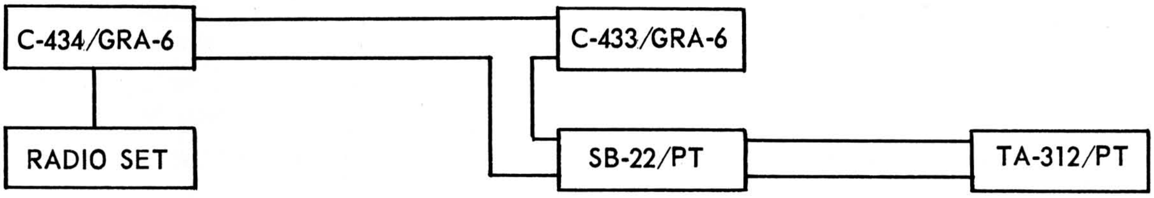
(*e*) At approximately 4 feet from the remote unit, cut *one* of the conductors of the twisted pair of field wires.

(*f*) Take the two new wire ends (step (*e*) above) and strip the insulation from their ends. Insert the bared ends into a pair of terminals on the switchboard.

(*g*) Identify this pair of terminals (step (*f*) above) by writing "RADIO" on the switchboard's identification strip.

(*h*) Tape down the PUSH-TO-TALK switch on the handset, and connect this handset to the audio receptacle on the remote unit.

(2) *Use.* Any field telephone user, by contacting the switchboard operator and requesting radio, can be connected to the remotely controlled radio. The radio operator can select either Set 1 or Set 2, as may be desired by the calling party. After the radio connection is made, the telephone user must remember two requirements: he must "push-to-talk and release-to-listen"; also, he must use radiotelephone procedure.



Telephones must be located within a 2-mile range of the radio set.

Figure 19. Wire connections for radio-wire integration through use of Control Group AN/GRA-6 with low-echelon radio and wire equipment.

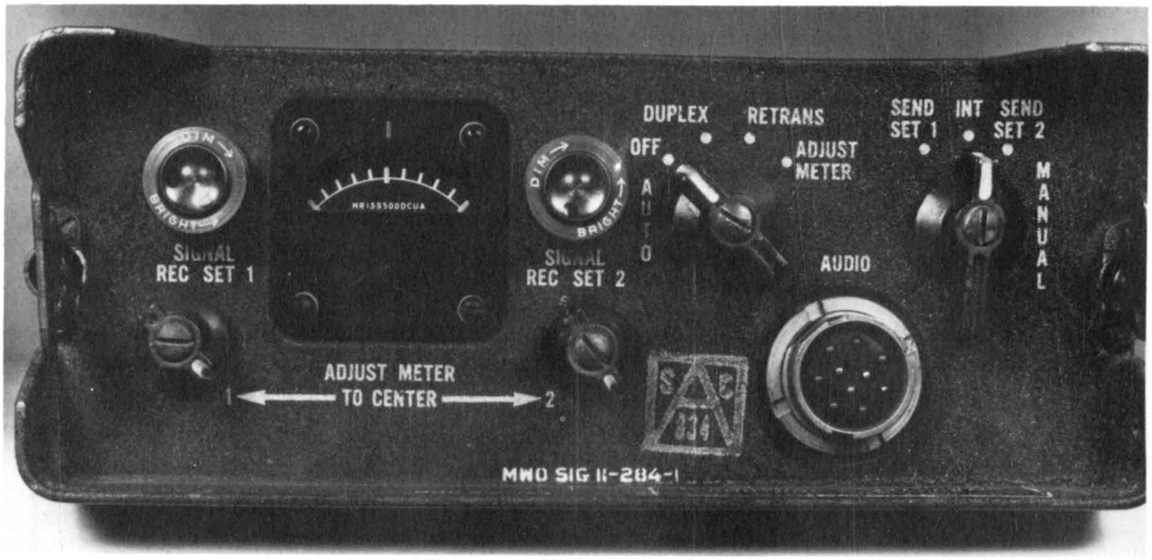


Figure 20. Control C-435/GRC.

22. CONTROL C-435/GRC

a. General. This unit (fig. 20) plugs into the mounting base and expands the operational facilities of Radio Sets AN/GRC-3 through -8 and AN/VRQ-1 through -3 to include full-duplex operation, automatic retransmission, and local control of Set 1 and Set 2. See figure 21 and 22.

b. Operating Procedures.

(1) *Operation of the radio from the audio receptacle on the retransmission unit.*

(*a*) Turn the AUTO switch *off.*

(*b*) To transmit on the receiver-transmitter on the left, hold the MANUAL switch in the SEND SET 1 position, press the PUSH-TO-TALK switch, and speak into the microphone.

(*c*) To transmit on the receiver-transmitter on the right, hold the MANUAL switch in the SEND SET 2 position, press the PUSH-TO-TALK switch, and speak into the microphone.

(*d*) To receive either or both sets, release the MANUAL switch and the PUSH-TO-TALK switch on the audio accessory.

(*e*) To transmit on the interphone, leave the MANUAL switch in the INT position, and:

1. Press the PUSH-TO-TALK switch and speak into the microphone.

2. If a head and chest set is used, press the RADIO switch and speak into the microphone.

(2) *Preparation for automatic retransmission.* (See fig. 21.)

Notes. 1. The set used as the retransmission station must have two receiver-transmitters on the one mount. For example, Radio Sets AN/GRC-3 or -4, or AN/VRQ-1 may be used.

2. Two clear and compatible channels must be obtained for this special purpose. One of the two receiver-transmitters on the mounting base must be tuned to one of the distant stations; the other receiver-transmitter must be tuned to the other distant station.

(*a*) Request a test signal from one of the distant stations. The test signal should be a steady vowel sound; for example, "EEEEEEEEE" or "AAHHHHHHHHHHHHH" may be used.

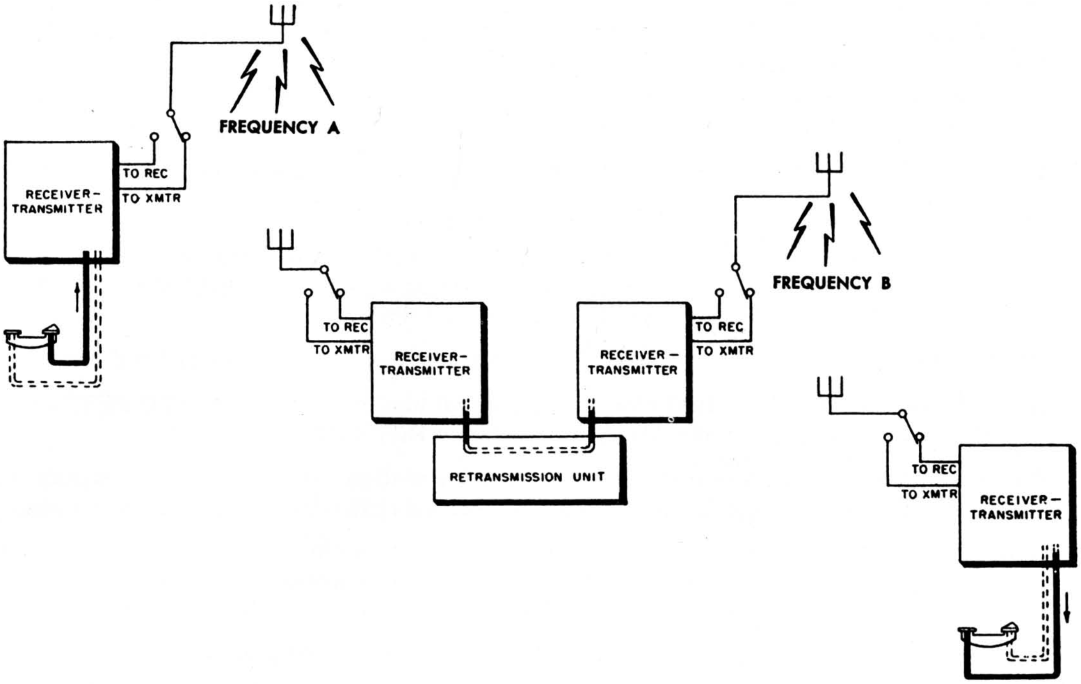


Figure 21. Retransmission system, block diagram.

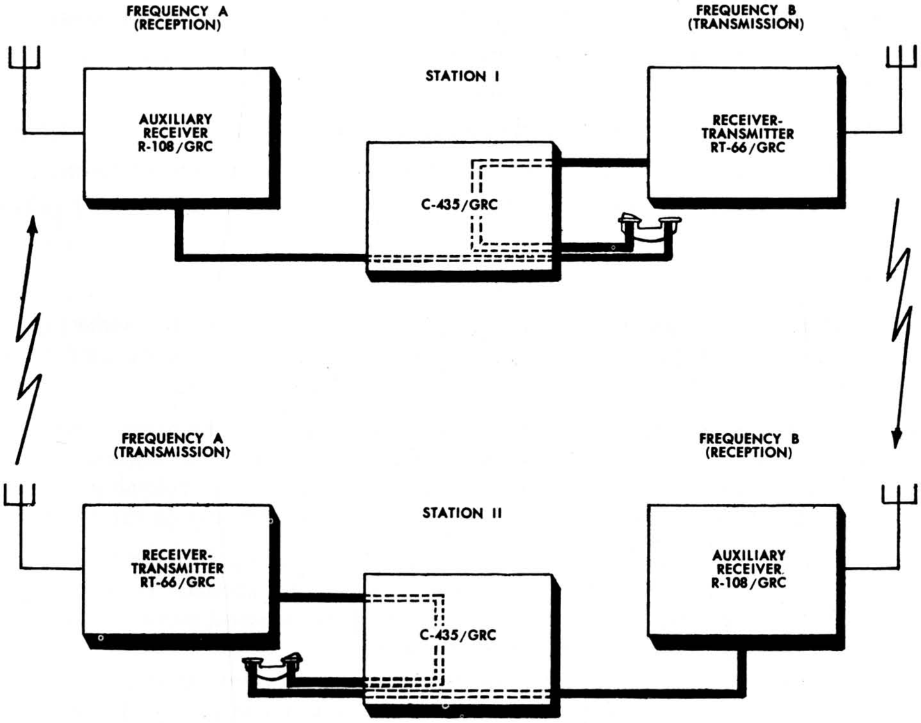

FREQUENCY A (RECEPTION)
FREQUENCY B (TRANSMISSION)
STATION I
AUXILIARY RECEIVER R-108/GRC
RECEIVER-TRANSMITTER RT-66/GRC
C-435/GRC
FREQUENCY A (TRANSMISSION)
FREQUENCY B (RECEPTION)
STATION II
RECEIVER-TRANSMITTER RT-66/GRC
AUXILIARY RECEIVER R-108/GRC
C-435/GRC

Figure 22. Full duplex operation, block diagram, employing Radio Set AN/GRC-3.

(*b*) As the test signal comes in, hold the AUTO switch in the ADJUST METER position and adjust the appropriate ADJUST METER TO CENTER control. (The appropriate meter will be SET 1, if the signal is being received on the set on the left; SET 2, if the signal is being received on the set on the right.) Adjust this control until the needle in the meter on the transmission unit is positioned at the center of the scale.

(*c*) Inform the distant station operator that his test signal was good, and tell him to WAIT.

(*d*) Call the other distant station and request a test signal.

(*e*) As his steady test signal is received, hold the AUTO switch in the ADJUST METER position and, while holding, turn the corresponding ADJUST METER TO CENTER control until the needle in the meter comes up to the center of the scale.

(*f*) Call the station operator and tell him that his test signal was good, and tell him to WAIT.

(*g*) Call the operator at the first station and request him to GO AHEAD WITH RETRANS. Then immediately place the AUTO switch in the RETRANS position.

(*h*) Maintain a listening watch at the retransmission station. All retransmitted signals will be heard. Periodic SQUELCH adjustments and METER adjustments may be necessary.

Note. SQUELCH adjustments at the retransmission station are critical. Any rushing noise from one receiver-transmitter will cause the other receiver-transmitter to transmit, and will make two-way retransmission impossible.

(3) *Duplex operation of Radio Set AN/GRC-3*. See figure 22 and paragraph 2 for diagram and definitions.

(*a*) *Preparation for duplex operation.* A retransmission unit (Control C-435/GRC) must be in the mount of each of the two sets.used.

1. Obtain two clear channels for operation.

2. Coordinate with the distant station as to which station is to transmit on frequency B.

Note. The following steps must then be taken at each of the two stations.

3. Disconnect the jumper wire between the auxiliary receiver and Set 1.

4. Provide the auxiliary receiver with a separate antenna.

5. Tune the auxiliary receiver to the frequency of the distant Set 1.

6. Tune Set 1 to the frequency of the distant station's auxiliary receiver.

7. Place the AUTO switch in the DUPLEX position. This causes Set 1 to transmit a constant carrier wave.

(*b*) *Duplex operation.*

1. To transmit, press the PUSH-TO-TALK switch and speak into handset (or headset microphone). While operating duplex, no waiting interval is necessary between the time the handset is pressed and the first words are spoken.

2. To receive, no switching is necessary as reception is continuous. The operator need not release the PUSH-TO-TALK switch to listen to the distant station. The VOLUME control on the interphone amplifier regulates the volume of received signals if the audio accessory is connected to the audio receptacle on the retransmission unit.

Notes. 1. Set 1 must be allowed to cool off after every 15 minutes of duplex operation. Allow 5 minutes for the cooling-off period. Turn the AUTO switch off. During the cooling-off period, occasional press-to-talk and release-to-listen contacts are permissible.

2. When Radio Set AN/VRQ-1 is used for duplex operation, the set on the left constantly transmits, and the set on the right constantly receives.

3. Figures 23 through 26 illustrate other audio accessories not discussed in this publication.

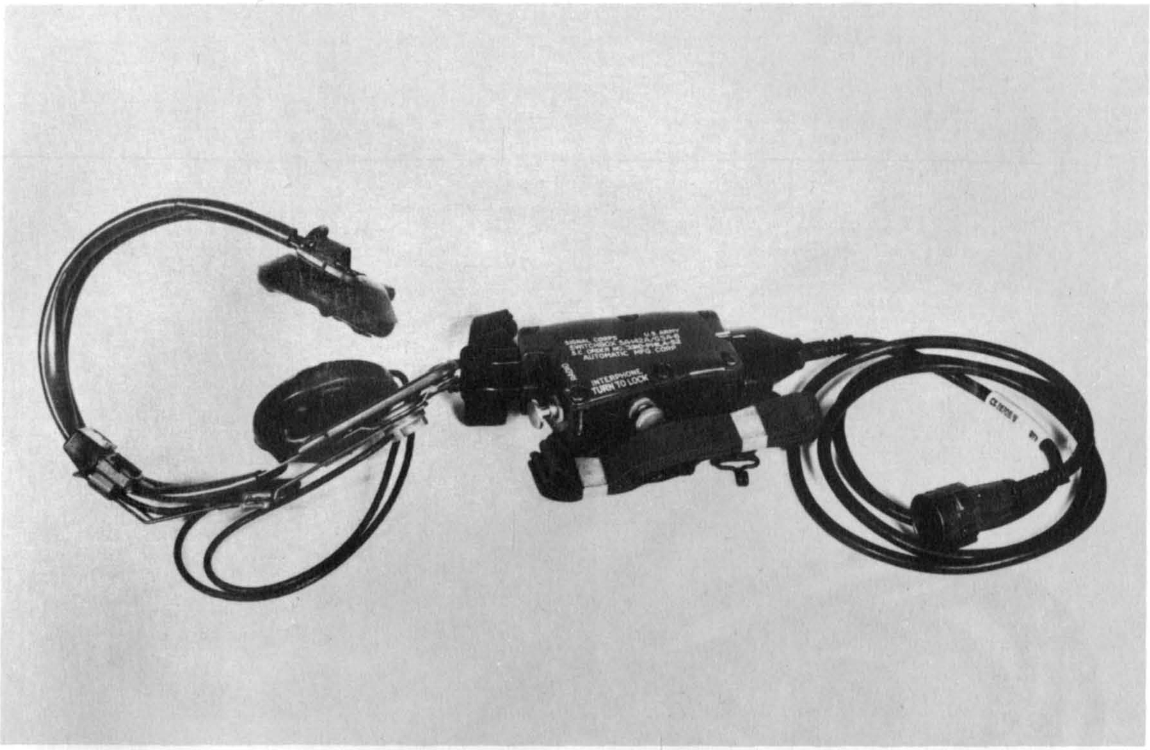


Figure 23. Chest Set Group AN/GSA-6 equipped with Switchbox SA-142A/GSA-6.

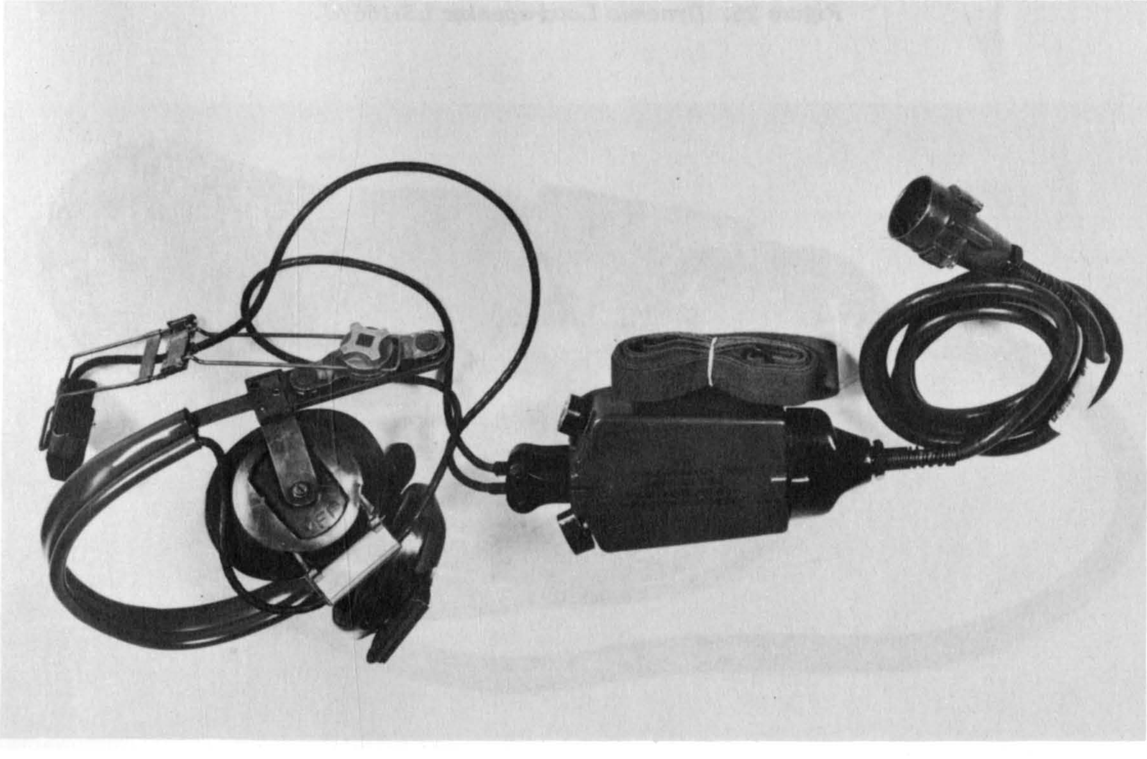


Figure 24. Chest Set Group AN/GSA-6 equipped with Switchbox SA-142C/GSA-6.

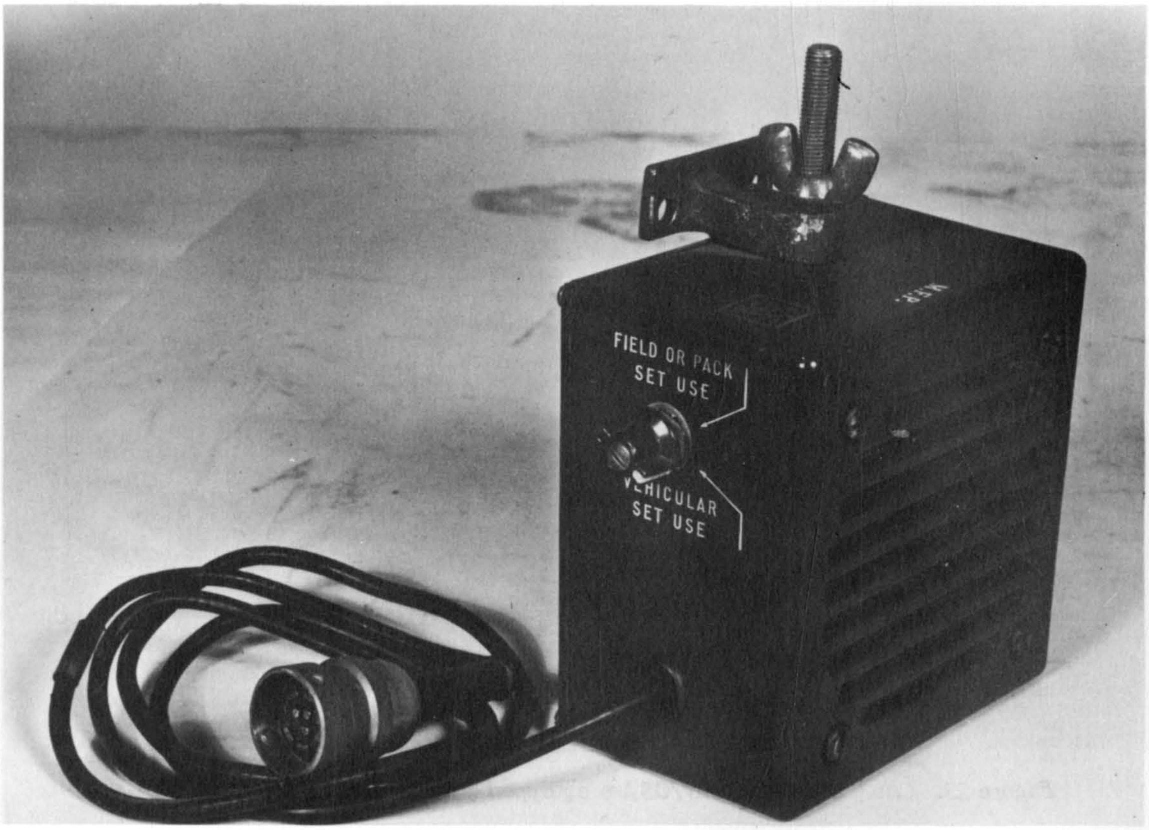


Figure 25. Dynamic Loud-speaker LS-166/U.

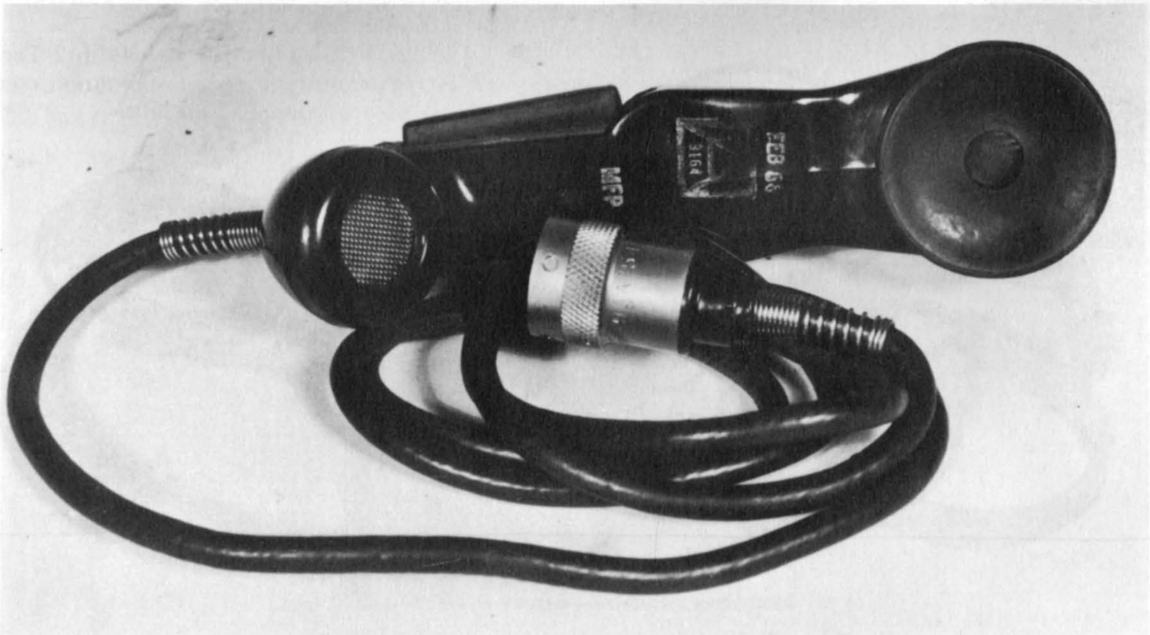


Figure 26. Handset H-33/PT.

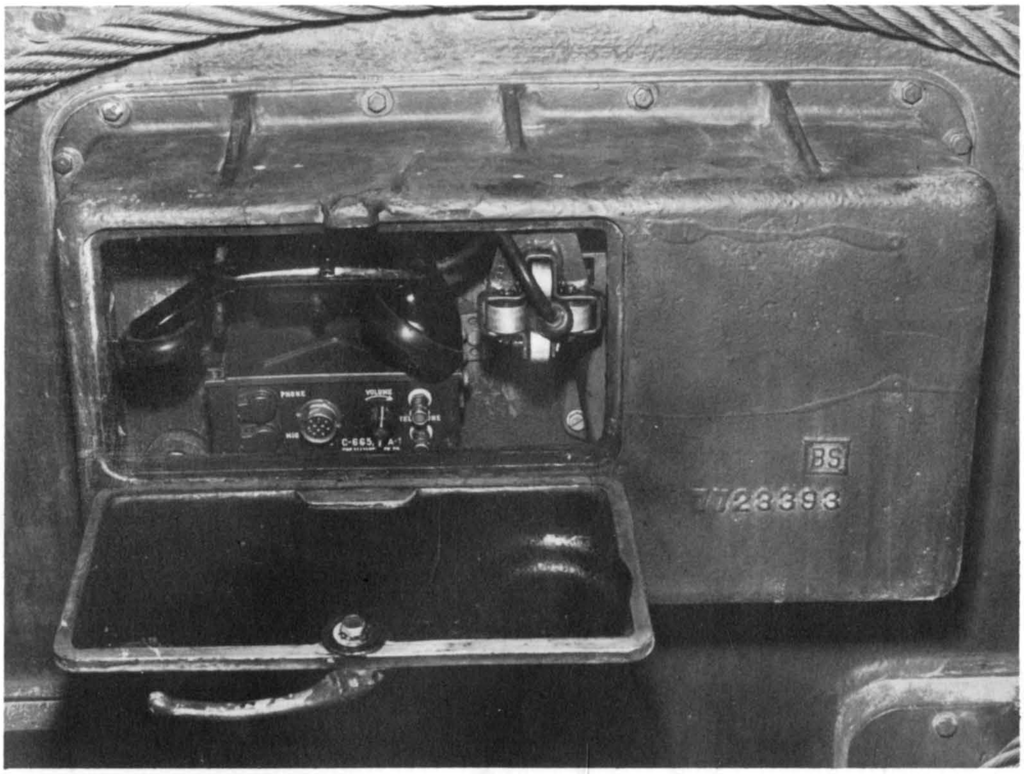


Figure 27. Auxiliary Interphone Equipment AN/VIA-1.

23. AUXILIARY INTERPHONE EQUIPMENT AN/VIA-1 AND AN/VIA-4

This equipment becomes part of the tank interphone system when it is switched on inside the tank. It is used to communicate from inside the tank to the outside rear of the tank. The AN/VIA-1 is part of all tanks except the M-48A2 Tank. The AN/VIA-4 is part of the M-48A2 Tank. The AN/VIA-1 has a telephone circuit independent of the interphone circuit from the external control box to the inside control boxes. The AN/VIA-4 does not have a telephone circuit.

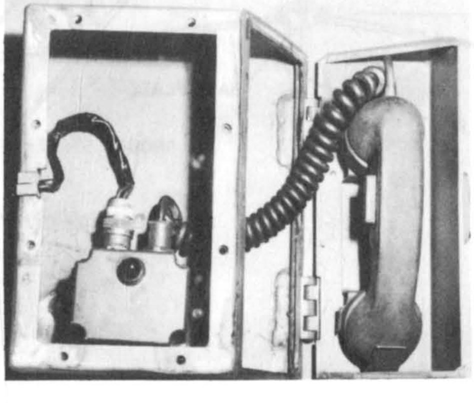


Figure 28. Auxiliary Interphone Equipment AN/VIA-4.

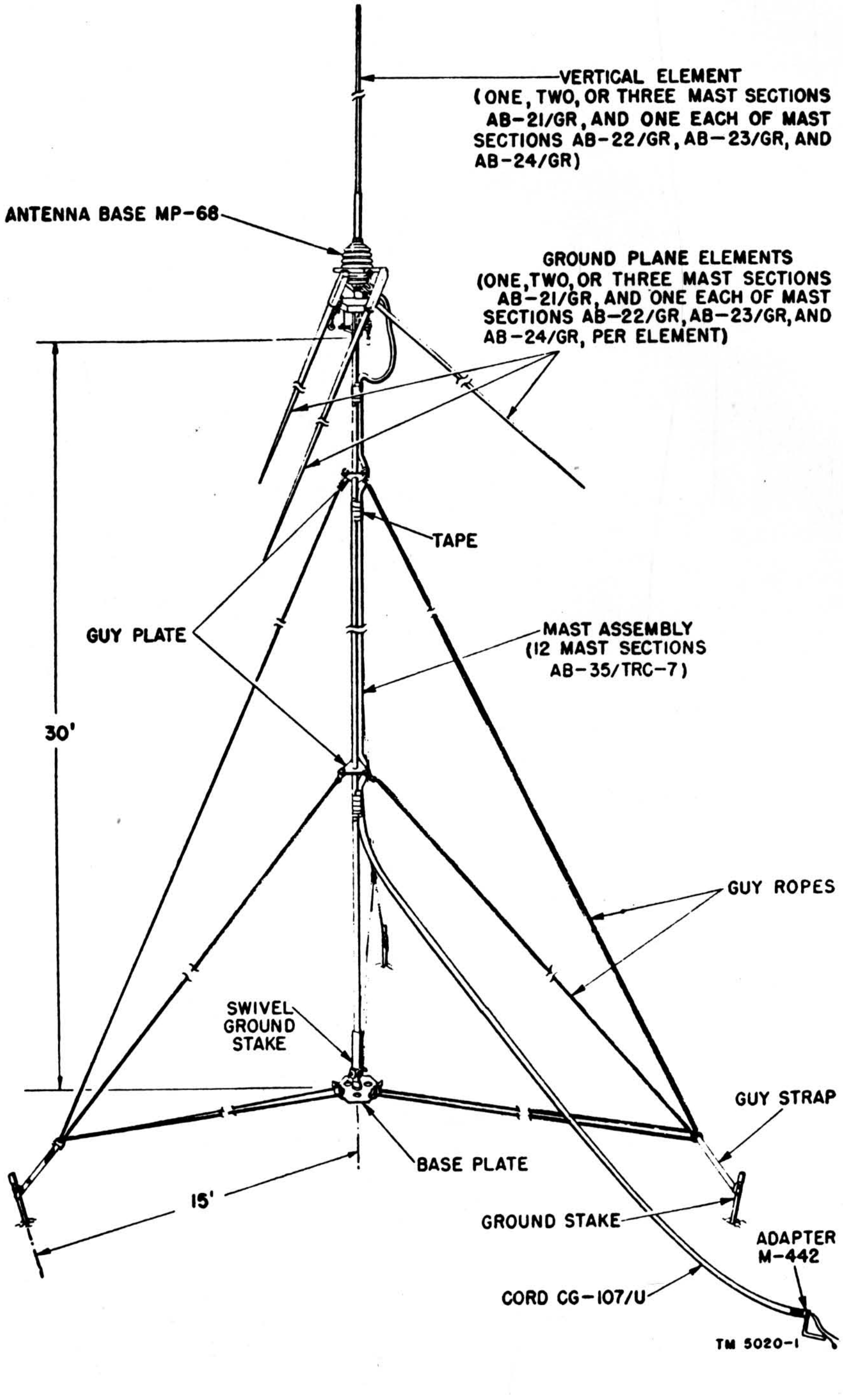

VERTICAL ELEMENT (ONE, TWO, OR THREE MAST SECTIONS AB-21/GR, AND ONE EACH OF MAST SECTIONS AB-22/GR, AB-23/GR, AND AB-24/GR)
ANTENNA BASE MP-68
GROUND PLANE ELEMENTS (ONE, TWO, OR THREE MAST SECTIONS AB-21/GR, AND ONE EACH OF MAST SECTIONS AB-22/GR, AB-23/GR, AND AB-24/GR, PER ELEMENT)
TAPE
GUY PLATE
MAST ASSEMBLY (12 MAST SECTIONS AB-35/TRC-7)
30'
GUY ROPES
SWIVEL GROUND STAKE
GUY STRAP
BASE PLATE
15'
GROUND STAKE
ADAPTER M-442
CORD CG-107/U
TM 5020-1

Figure 29. Antenna Equipment RC-292.

24. ANTENNA EQUIPMENT

a. Antenna Equipment RC-292. This is an elevated, wide band, modified ground plane antenna (fig. 29) designed to operate with, and increase the distance range of, FM radio sets. The length of the antenna elements must be preadjusted for the different frequencies of the radio sets with which it is used. This is accomplished by changing the number of antenna mast sections which make up the antenna elements.

b. Technical Characteristics.

(1) *Radio sets with which used.* All FM radios (20.0 to 70.0 mc).

(2) *Frequency range.* The frequency range is dependent on the number of antenna sections used.

Frequency	*Nr of Antenna Sections*			
	AB-21	*AB-22*	*AB-23*	*AB-24*
20.0 mc to 27.9 mc	3	1	1	1
27.0 mc to 38.9 mc	1	1	1	1
38.0 mc to 54.4 mc	1	1	1	
54.0 mc to 70.0 mc	1	1		

Note. Use the same number of sections for ground plane elements.

(3) *Planning ranges.*

(*a*) Between two Sets 1, each equipped with Antenna Equipment RC-292, up to 36 miles; between two Sets 1, one equipped with a regular whip antenna and the other with Antenna Equipment RC-292, up to 25 miles.

(*b*) Between two Radio Sets AN/PRC-8, -9, or -10, each equipped with Antenna Equipment RC-292, up to 12 miles; between two Radio Sets AN/PRC-8, -9, or -10, one equipped with the long whip antenna and the other with Antenna Equipment RC-292, up to 8 miles.

(4) *Erection time.* 15 minutes.

(5) *Erected height.* 41½ feet.

(6) *Weight (complete).* 48 pounds.

Section VI. AM RADIO EQUIPMENT

25. GENERAL

a. Armor units frequently operate beyond the limited range of FM radios. Therefore, AM radios are authorized down to battalion level and, in the case of the armored cavalry squadron, down to armored cavalry troop level. AM radios not only are capable of greater distance range than FM radios, but also have a greater traffic-handling capacity. Recently developed AM radios provide simultaneous voice-radioteletype communication.

b. AM radios operate in the high frequency band (fig. 30) and are employed commonly throughout the Army without regard to armor, artillery, or infantry band frequencies. In armor units, AM radios are installed in wheeled and tracked vehicles and can be operated while the vehicle is stationary or in motion. Doublet or long-wire antennas can be used while stationary to obtain greater distance ranges. Trained communication specialists are required for operation of AM radios.

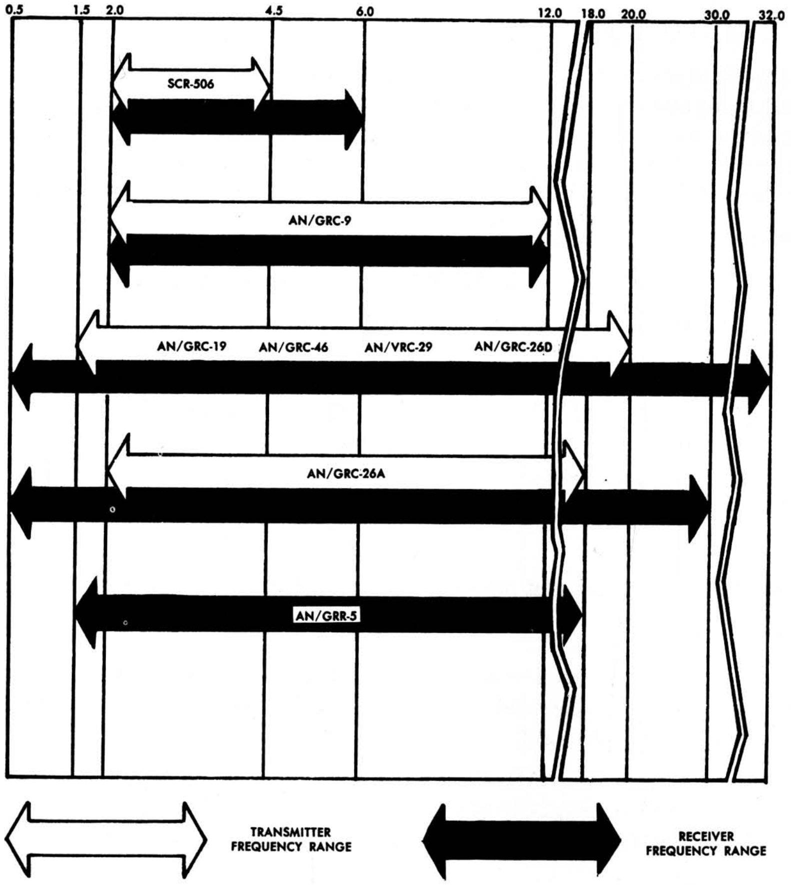


Figure 30. Frequency ranges (in megacycles) of AM radio sets.

26. RADIO SET AN/GRC-9

Radio Set AN/GRC-9 (fig. 31) is a medium-power, combined two-way radiotelephone and radiotelegraph unit designed to provide communication between moving or stationary vehicles. The radio set consists of Receiver-Transmitter RT-77/GRC-9, Dynamotor Power Supply DY-88/GRC-9, Generator GN-58, and a number of associated operating components. Generator GN-58 is a hand-operated power source which enables the Radio Set AN/GRC-9 to be used as a portable field set; however, it is seldom used in this manner in armor units. The Radio Set AN/GRC-9 is found in the armored division aviation company, the armored division engineer battalion, and the armored division ordnance battalion. The AN/GRC-9 (less field components), when vehicular mounted, becomes Radio Set AN/VRC-34.

a. Frequency Range. 2.0 to 12.0 mc (in three bands).

b. Number of Crystals.

(1) Transmitter—2 in each band, or a total of 6.

(2) Receiver—1 for calibration.

c. Type of Tuning. Continuous MO or six crystal frequencies.

d. Calibration. Built-in calibration check points in the receiver at 200-kc intervals.

e. Type of Signal. CW, MCW, or voice (amplitude modulated).

f. Power Source.

(1) 12- or 24-volt vehicular battery through Dynamotor Power Supply DY-88/GRC-9.

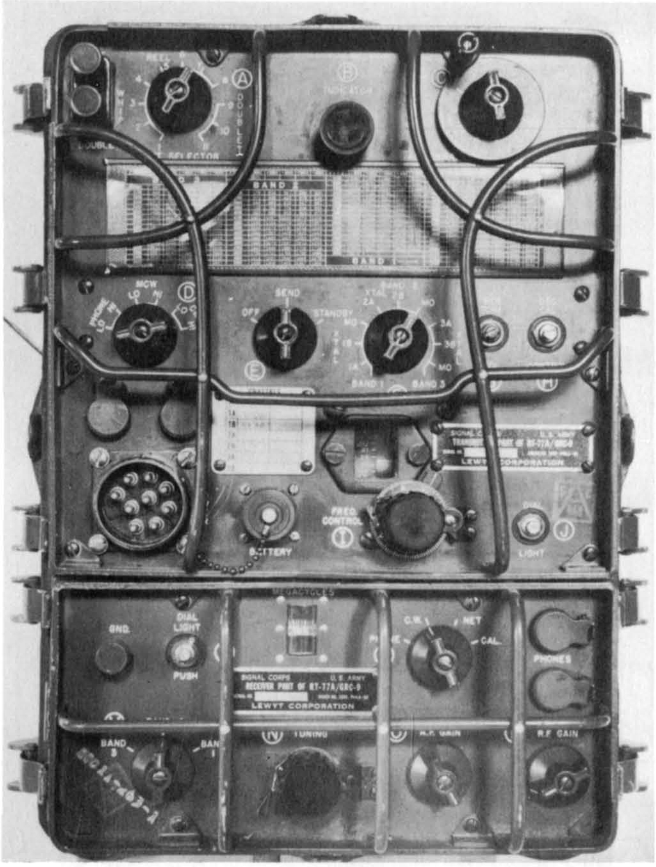


Figure 31. Radio Set AN/GRC-9.

(2) Hand-operated Generator GN-58 for portable use.

(3) Battery BA-48 (receiver operation only).

Note. Vibrator Power Unit PE-237 is issued in lieu of Dynamotor Power Supply DY-88/GRC-9.

g. Power Output. Maximum of 7 watts on phone; 15 watts on CW with Dynamotor Power Supply DY-88/GRC-9.

h. Approximate Range.

(1) CW–Stationary, 75 miles; moving, 30 miles.

(2) Voice–Stationary, 25 miles; moving, 15 miles.

i. Antenna.

(1) Whip antenna–15 feet long, consisting of Mast Sections MS-116-A (3 each), MS-117-A, and MS-118-A.

(2) Long wire antenna–244.5 feet long. (The 137-foot length has a calibration chart attached; 107.5 feet of the 244.5-foot length is detachable.)

j. Pertinent Publication. TM 11-263.

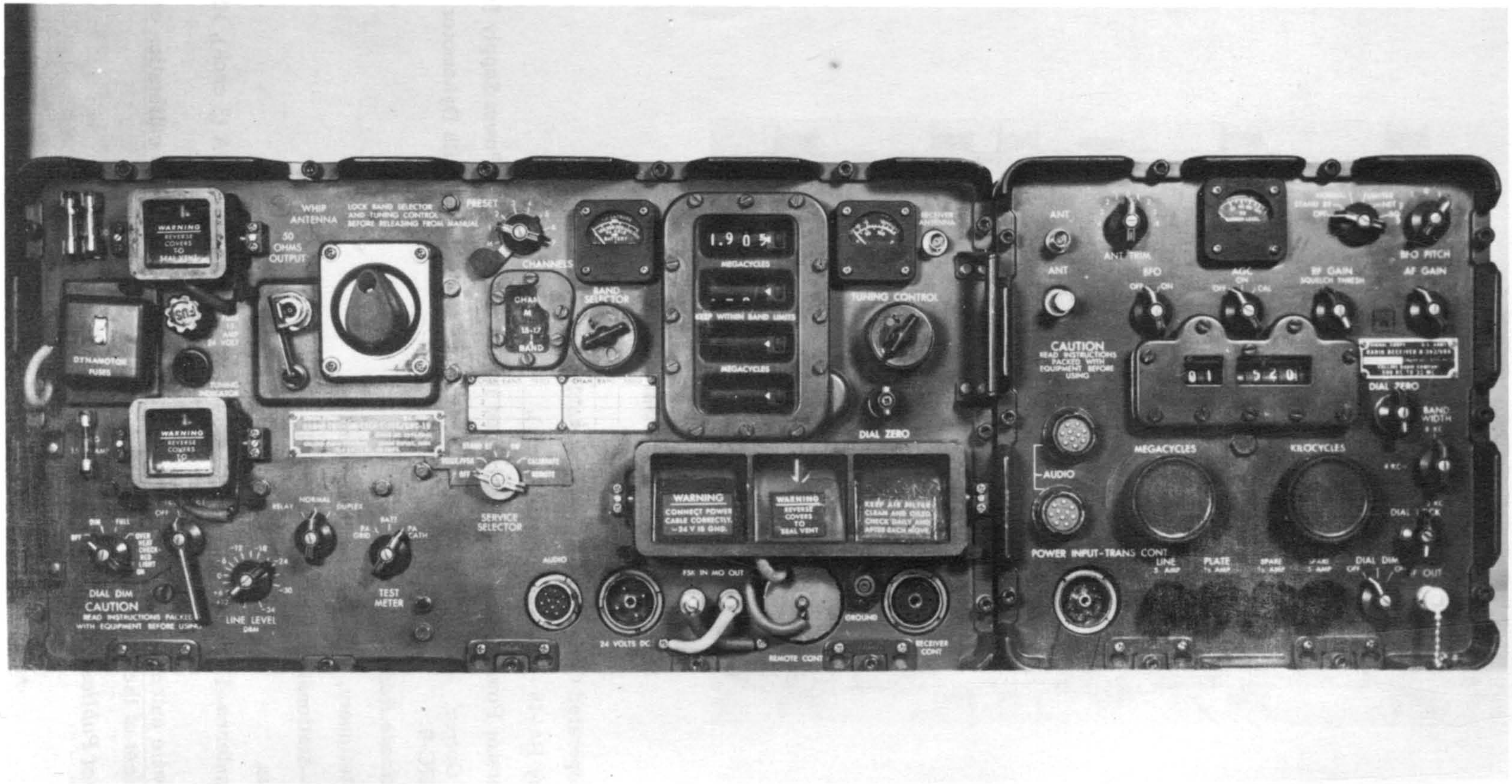


Figure 32. Radio Set AN/GRC-19.

27. RADIO SET AN/GRC-19

Radio Set AN/GRC-19 (fig. 32) is a medium-power radio set consisting of Radio Transmitter T-195/GRC-19, Radio Receiver R-392/URR, and associated operating components. Radio Set AN/GRC-19 is designed to provide CW or voice communication between moving or stationary vehicles. Facilities are provided in the transmitter for remote control of power, selection of channels, and type of service, which enables the radio set to be integrated into wire systems in the field. Radio Set AN/GRC-19 is used as a basic component in Radio Sets AN/VRC-29 and AN/GRC-46. Radio Set AN/GRC-19 is authorized throughout the armored division down to battalion level, and down to armored cavalry troop level in the armored cavalry squadron. The AN/GRC-19, along with Radio Sets AN/VRC-29 and AN/GRC-46, will replace Radio Set SCR-506.

a. *Frequency range.*

(1) Transmitter—1.5 to 20.0 mc.

(2) Receiver—0.5 to 32.0 mc.

b. *Number of crystals.* 1 (for calibration only).

c. *Type of tuning.*

(1) Transmitter—MO with 7 preset automatically tuned channels and 1 manually tuned channel.

(2) Receiver—Continuous manual tuning.

d. *Calibration.* Built-in calibration check points in the receiver at 100-kc intervals.

e. *Types of signal.* CW, voice (AM), FSK, or FSK and voice.

f. *Power source.* 24-volt vehicular battery. A dynamotor type power supply is contained within the transmitter; the receiver uses the 24-volt battery voltage as a plate supply.

g. *Power output.* 100 watts maximum.

h. *Planning range.*

(1) CW—75 miles.

(2) Voice—50 miles.

Note. Ranges given are for sets with whip antenna.

i. *Antenna.*

(1) Whip antenna—15 feet long, consisting of Mast Sections MS-116-A (3 each), MS-117-A, and MS-118-A.

(2) Doublet antenna.

j. *Pertinent Publication.* TM 11-274.

k. *Preliminary Operating Instructions.*

Warning.
1. The voltages used in this equipment are high enough to cause death.
2. The transmitter and the receiver must be grounded. This is necessary for the protection of the radio set and personnel. There are two ground straps on the mounting for grounding the radio set to the mounting. The mounting must be connected to a ground rod (or other ground connection).
3. Do not operate the transmitter unless it is connected to an antenna.
4. While the transmitter is operating, high RF power is present at the antenna and the antenna leadin. Do not come into contact with the antenna or leadin, as this may cause severe burns or shock.
5. Do not move the cover guard from the 50-OHM output connector when using the whip antenna binding post.
6. When the PRESET switch on the transmitter is turned, the BAND SELECTOR and the TUNING CONTROL must be locked.

Note. The following steps must be performed in the sequence given.

(1) *Steps for turning on and warming up the receiver.*

(*a*) Connect the speaker or phones to AUDIO.

(*b*) Turn the BFO switch to ON.

(*c*) Turn BFO PITCH to 0.

(*d*) Turn AGC to ON.

(*e*) Adjust RF GAIN to three o'clock.

(*f*) Turn AF GAIN to maximum.

(*g*) Unlock DIAL LOCK (counterclockwise).

(*h*) Unlock DIAL ZERO (counterclockwise).

(*i*) Turn BAND WIDTH to 8 KC.

(*j*) Turn OFF-STANDBY-NORMAL to STANDBY.

Note. While the receiver is warming up, proceed with the transmitter.

(2) *Steps for turning on and warming up the transmitter.*

(*a*) Check SEAL VENTS—ensure that they are open (red decals should show).

(*b*) Turn OFF-DIM-FULL to FULL.

(*c*) Turn RELAY-NORMAL-DUPLEX to NORMAL.

(*d*) Turn TEST METER to PA CATH.

(*e*) Lock BAND SELECTOR.

(*f*) Lock TUNING CONTROL.

(*g*) Connect key microphone to AUDIO.

(*h*) Turn SERVICE SELECTOR to STANDBY.

Note. While the transmitter is warming up, proceed with receiver calibration.

(3) *Steps for calibrating the receiver.*

(*a*) Turn MEGACYCLES to megacycles desired.

(*b*) Turn KILOCYCLES to the whole 100-KC point nearest to the desired frequency.

(*c*) Turn AGC to CALIBRATE.

(*d*) Turn STANDBY-NORMAL-LIMITER to NORMAL.

(*e*) Lock DIAL ZERO.

(*f*) Adjust KILOCYCLES for zero beat.

(*g*) Unlock DIAL ZERO.

(*h*) Adjust KILOCYCLES to desired frequency.

(*i*) Turn AGC to ON.

(*j*) Turn OFF-STANDBY-NORMAL to NET.

Note. The following preliminary operating instructions are for setting one preset channel on the transmitter.

(4) *Steps for calibrating the transmitter.*

(*a*) Turn PRESET to channel desired. (Wait for motors to stop.)

(*b*) Unlock BAND SELECTOR.

(*c*) Adjust BAND SELECTOR to desired band. (Do not use force.)

Note. Line up index lines.

(*d*) Lock BAND SELECTOR.

(*e*) Unlock TUNING CONTROL.

(*f*) Turn SERVICE SELECTOR to CALIBRATE.

(*g*) Turn RELAY-NORMAL-DUPLEX to DUPLEX.

(*h*) Adjust TUNING CONTROL for zero beat. Do not use force. If tone cannot be heard, advance the RF GAIN control.

(*i*) Lock TUNING CONTROL.

(*j*) Depress DIAL ZERO and correct the dial reading. Do not use force.

Notes. 1. For presetting additional channels, repeat steps (3)(*a*) through (*j*) and (4)(*a*) through (*j*).

2. For manual setting of the transmitter turn PRESET to M (step (4)(*a*), above) and follow steps (1) through (4).

3. Steps (4)(*k*) through (4)(*r*) are for final adjustment after all desired presets are alined.

(*k*) Turn SERVICE SELECTOR to VOICE or CW.

(*l*) Turn RELAY-NORMAL-DUPLEX to NORMAL.

(*m*) Press the switch on the microphone (or telegraph key) and hold it closed until the TUNING INDICATOR glows steadily.

(*n*) Turn BFO to OFF if operating voice.

(*o*) Turn OFF-STANDBY-NORMAL to NORMAL.

(*p*) Turn RF GAIN to maximum.

(*q*) Adjust AF GAIN to desired volume.

(*r*) Adjust ANT TRIM for maximum CARRIER LEVEL reading.

Notes. 1. When changing preset channels, turn PRESET switch to channel desired and accomplish steps (3)(*a*) through (3)(*h*) and (4)(*m*) through (4)(*r*).

2. The radio is now tuned.

l. Operation. To transmit, press the microphone PUSH-TO-TALK switch. Release the PUSH-TO-TALK switch to listen.

28. RADIO TELETYPEWRITER SET AN/GRC-46

a. General. Radioteletypewriter Set AN/GRC-46 is a mobile, medium-power, radioteletype set mounted in a specially designed compact shelter. The shelter, in turn, is normally mounted on a ¾-ton truck. Figure 77 illustrates the extent to which this equipment is used in the armored division. When used primarily for communication from division main elements to major elements within the division, this radioteletypewriter set provides capability for sending and receiving 60 words per minute by teletype. It has tape-punching and keyboard- or tape-sending equipment. The receiver and the transmitter are the same as those of the Radio Set AN/GRC-19. This means that voice and CW transmission and reception also are capabilities of this radioteletypewriter set. The set is arranged so that it can be easily adapted to on-line cryptographic operation. Radioteletypewriter Set AN/GRC-46 consists of the following major components:

(1) Shelter S-89C/G.

(2) Transmitter T-195/GRC-19.

(3) Receiver R-392/URR.

(4) Teletypewriter TT-98B/FG.

(5) Teletypewriter Reperforator-Transmitter TT-76(*)/GGC.

(6) Modulator MD-203/GR.

(7) Frequency Shift Converter CV-278/GR.

(8) Interconnecting Box J-668/GR.

Note. See Radio Set AN/GRC-19 for details of transmitter and receiver. See figures 34 through 38 for descriptions of other components.

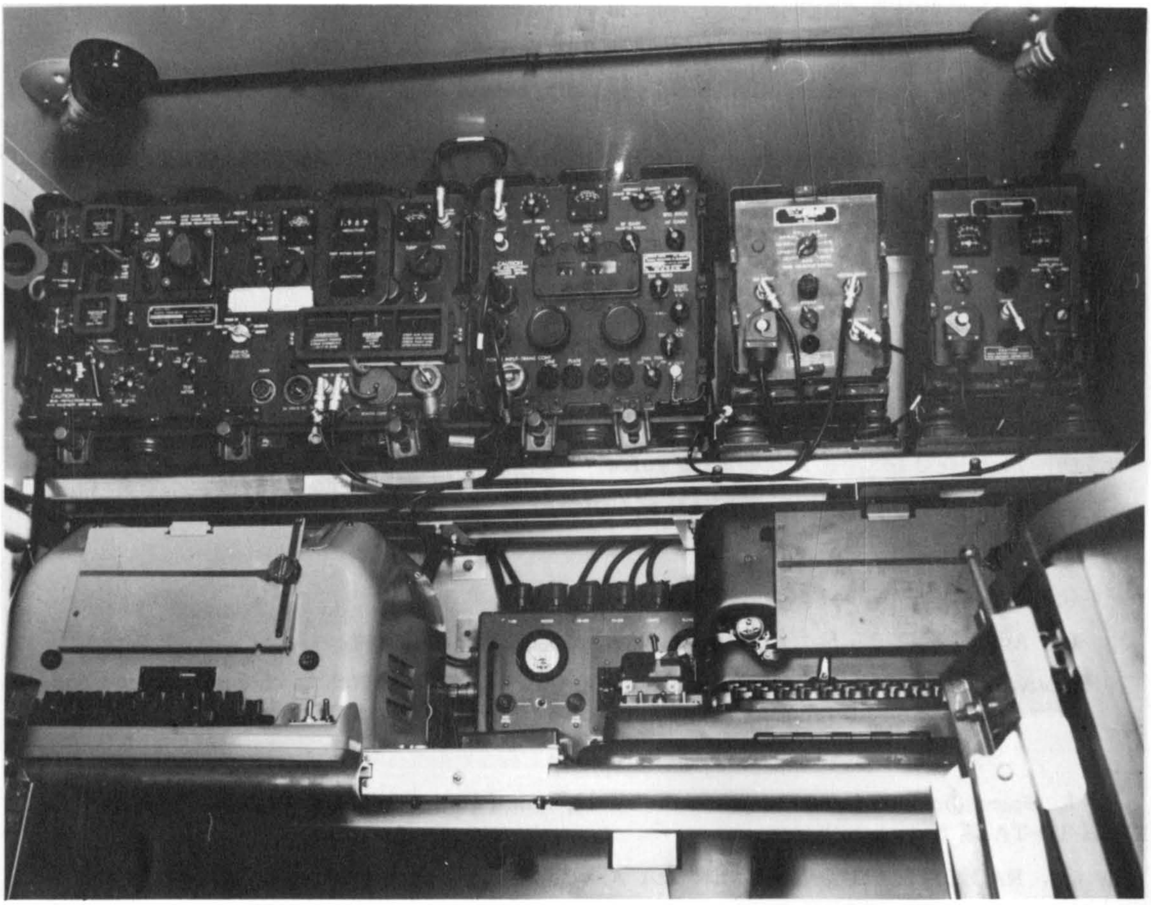


Figure 33. Radio Set AN/GRC-46.

b. Characteristics.

(1) *Frequency range.*

(*a*) Transmitter–1.5 to 20.0 mc.

(*b*) Receiver–0.5 to 32.0 mc.

(2) *Number of crystals.* 1 (for calibration only).

(3) *Type of tuning.*

(*a*) Transmitter–MO with 7 preset automatically tuned channels and 1 manually tuned channel.

(*b*) *Calibration.* Built-in calibration check points in the receiver at every 200-kc point.

(5) *Type of signal.* CW, FSK, or voice (amplitude modulated), or voice and FSK simultaneously.

(6) *Power source.* 24-volt vehicular battery. Individual components have their own power supplies. A rotary converter furnishes power for teletypewriter motors.

(7) *Power output.* Maximum of 100 watts.

(8) *Planning range.*

(*a*) CW–75 miles.

(*b*) Voice or Voice and RTT simultaneously—50 miles.

Note. Ranges given are for radios equipped with whip antennas.

(9) *Antennas.*

(*a*) Whip antenna—The antenna is 15 feet long and consists of Mast Sections MS-116-A (3 each), MS-117-A, and MS-118-A.

(*b*) *Doublet antenna.*

(10) *Teletype speed.* 60 words per minute.

(11) *Pertinent publication.* TM 11-5815-204-10.

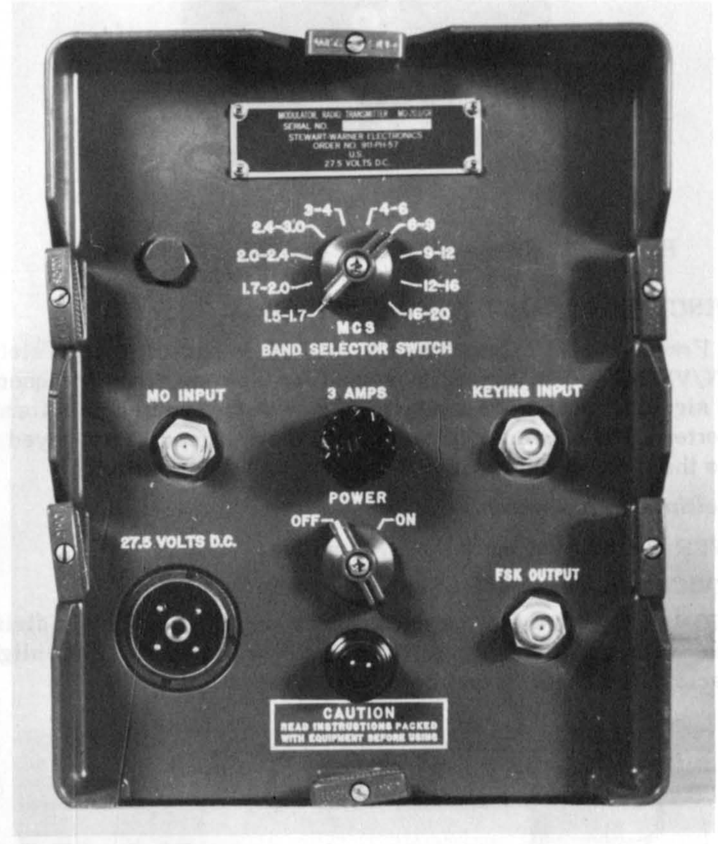


Figure 34. Frequency Modulator M-203( )/GR.

29. MODULATOR MD-203/GR

a. General. Frequency Modulator MD-203/GR (Frequency Shift Keyer) is a component of Teletypewriter Sets AN/GRC-46 and AN/VRC-29. While *transmitting*, a teletypewriter creates a pattern of DC impulses, which are fed to the modulator. The DC impulses, through the action of the modulator, cause the frequency of the radio carrier wave to be shifted in a pattern corresponding to these impulses. Thus the intelligence signal is imposed on the carrier wave, and is put in a receivable form.

b. Control Settings for Operation.

(1) The POWER switch must be in the ON position.

(2) The BAND SELECTOR SWITCH position must match the particular band of frequencies currently tuned on Transmitter T-195/GRC-19.

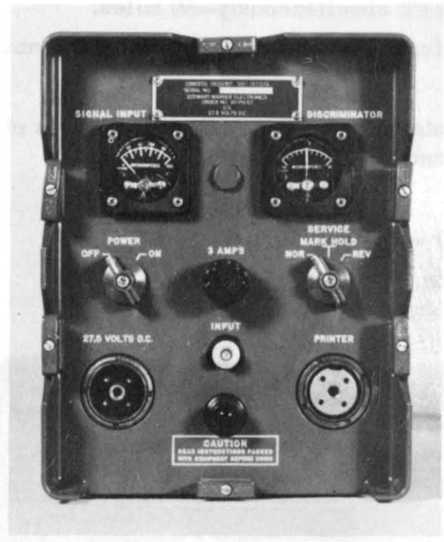


Figure 35. Frequency Shift Converter CV-278( )/GR.

30. FREQUENCY SHIFT CONVERTER CV-278/GR

a. General. Frequency Shift Converter CV-278/GR is part of Radio Teletypewriter Sets AN/GRC-46 and AN/VRC-29. The converter is used for the *reception* of frequency-shift-keyed radioteletypewriter signals. While *receiving,* frequency-shift-keyed signals from the radio receiver are fed to the converter. The converter then converts the frequency-shift-keyed signals to DC impulses, and feeds these DC impulses into the receiving teletypewriter.

b. Control settings for operation.

(1) The POWER switch must be in the ON position.

(2) The SERVICE switch must be in the NOR position.

Note. The SIGNAL INPUT meter indicates input signal level. Scale divisions represent arbitrary values. The DISCRIMINATOR meter should oscillate slightly back and forth across the center (zero) point during reception.

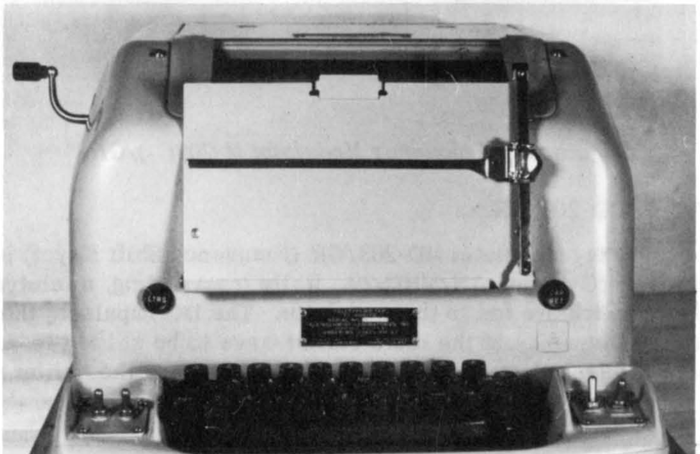


Figure 36. Teletypewriter TT-98B/FG.

31. TELETYPEWRITER TT-98B/FG

a. General. Teletypewriter TT-98B/FG is a page-printing, keyboard-sending teletypewriter designed for use on direct-wire, carrier, or radioteletype circuits. It is part of the equipment of Radio Teletypewriter Sets AN/GRC-46 and AN/VRC-29. It presently is set up to operate at 60 words per minute; it is capable, however, of 66, 75, or 100 words-per-minute operation. The user can type 72 characters per line. A bell signals the typist before the end of every line, but if he fails to return the carriage in a normal fashion, the carriage will automatically return itself. A LTRS button and CAR RET button (see fig. 36) are readily accessible to the user. While observing an incoming page-printed copy, if the machine fails to go into lower case (letters) properly, or if the carriage fails to return, the user can press the proper button and cause the action desired. Page-printed copies (and carbon copies as desired) of all sent and received traffic are obtained.

b. Use with Radio Teletypewriter Sets. With Radio Teletypewriter Sets AN/GRC-46 and AN/VRC-29, keyboard sending is seldom used because these sets have tape punching and sending equipment. (See Teletypewriter Reperforator-Transmitter TT-76( ) GGC.)

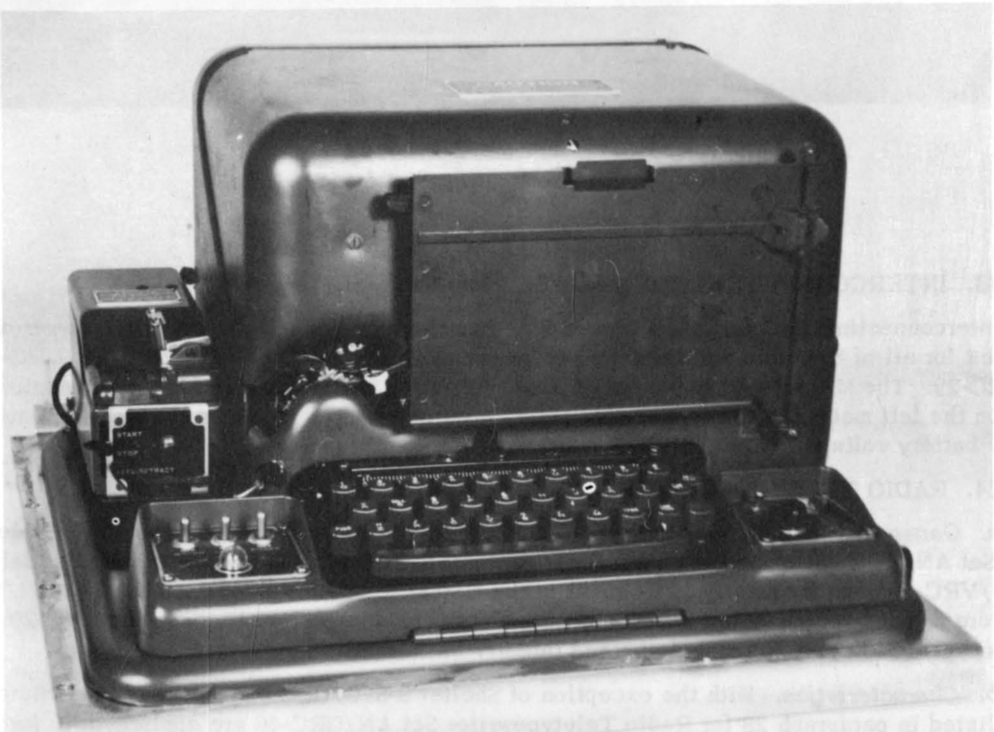


Figure 37. Teletypewriter-Reperforator-Transmitter TT-76( )/GGC.

32. TELETYPEWRITER REPERFORATOR-TRANSMITTER TT-76( )/GGC

Teletypewriter Reperforator-Transmitter TT-76( )/GGC is part of Radio Teletypewriter Sets AN/GRC-46 and AN/VRC-29. The keyboard of this teletypewriter is used to punch out messages on a paper tape of 7/8-inch width. The tape, in turn, can then be sent through an automatic tape sending device which is also part of this teletypewriter. As the taped message is transmitted, a page printed copy of the message appears simultaneously on Teletypewriter TT-98B/FG, if desired. Controls of the TT-76( )GGC can also be arranged to punch out a tape of any received traffic. This expedites message relaying. In addition to perforating the tape, this machine prints a readable copy of the message along the length of the tape.

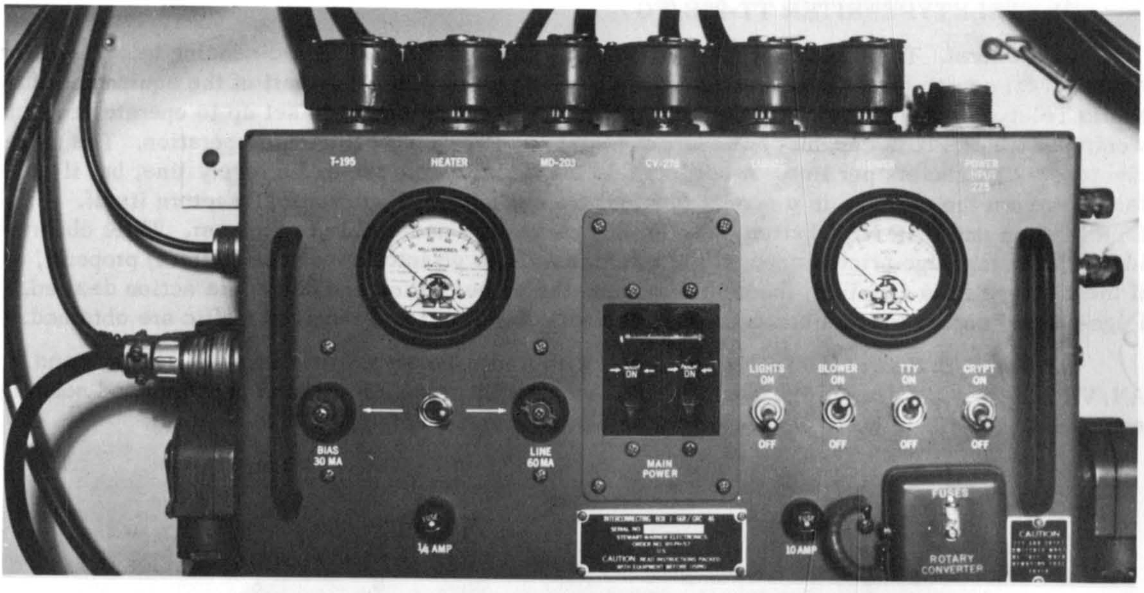


Figure 38. Interconnecting Box J-668/GR.

33. INTERCONNECTING BOX J-668/GR

Interconnecting Box J-668/GR serves as a junction box and master power-on, power-off control point for all of the radio and teletype equipment of Radio Teletypewriter Sets AN/GRC-46 and AN/VRC-29. The MAIN POWER control is a master power switch for all of the equipment. The meter on the left measures teletypewriter operating currents. The meter on the right measures primary battery voltage. Other ON-OFF controls are self-explanatory.

34. RADIO TELETYPEWRITER SET AN/VRC-29

a. General. Radio Teletypewriter Set AN/VRC-29 is exactly the same as Radio Teletypewriter Set AN/GRC-46, except for the manner in which it is installed. In the armored division, the AN/VRC-29 most frequently is mounted in the M59 armored personnel carrier. The AN/VRC-29 is of more direct concern to low-echelon commanders than the GRC-46 because the VRC-29 equipment is organic to every armor and armored infantry battalion.

b. Characteristics. With the exception of Shelter S-89C/G, the components and characteristics listed in paragraph 28 for Radio Teletypewriter Set AN/GRC-46 are applicable to Radio Teletypewriter Set AN/VRC-29. The pertinent publication for the AN/VRC-29 is TM 11-5815-204-10.

35. RADIO SET AN/GRC-26A

Radio Set AN/GRC-26A (fig. 39 and 40) is a mobile, high-power, radioteletype set normally mounted in Shelter S-69/GRC on a 2½-ton truck. Facilities are provided for operation of full-duplex or one-way reversible circuits. Radio Set AN/GRC-26A consists of Radio Transmitter BC-610-H, two Radio Receivers R-388/URR, Frequency Shift Converter CV-182/GRC-26, two Teletypewriters TT-4/TG, Perforator Transmitter TT-56/MGC, and other associated equipment. The complete radio set is sufficiently compact to be transported in an assault-type aircraft. There are five Radio Sets AN/GRC-26A in the armored division signal battalion. For their employment, see figure 77, note 4.

a. *Frequency Range.*

(1) Transmitter—2.0 to 18.0 mc.

(2) Receiver—0.5 to 30.5 mc (in 30 bands).

b. *Number of Crystals.* None (except those used in the receivers for calibration).

Note. Crystals can be obtained for crystal control of the transmitter but are not issued with the equipment.

c. *Type of Tuning.*

(1) Transmitter—continuous, master oscillator, or crystal.

(2) Receiver—continuous.

d. *Calibration.* Built-in crystal check points in the receiver at 100-kc intervals.

e. *Type of Signal.* CW, FSK, or voice (amplitude modulated). Also, simultaneous FSK and voice.

f. *Power Source.* Towed Power Unit PE-95 (115 volts, 60 cycles). Individual components have their own power supplies.

g. *Power Output.* Voice, 300 watts; CW or FSK, 400 watts.

h. *Approximate Range.* Voice, 100 miles; CW or FSK, 250 miles.

Note. The ranges given are for sets equipped with a whip antenna.

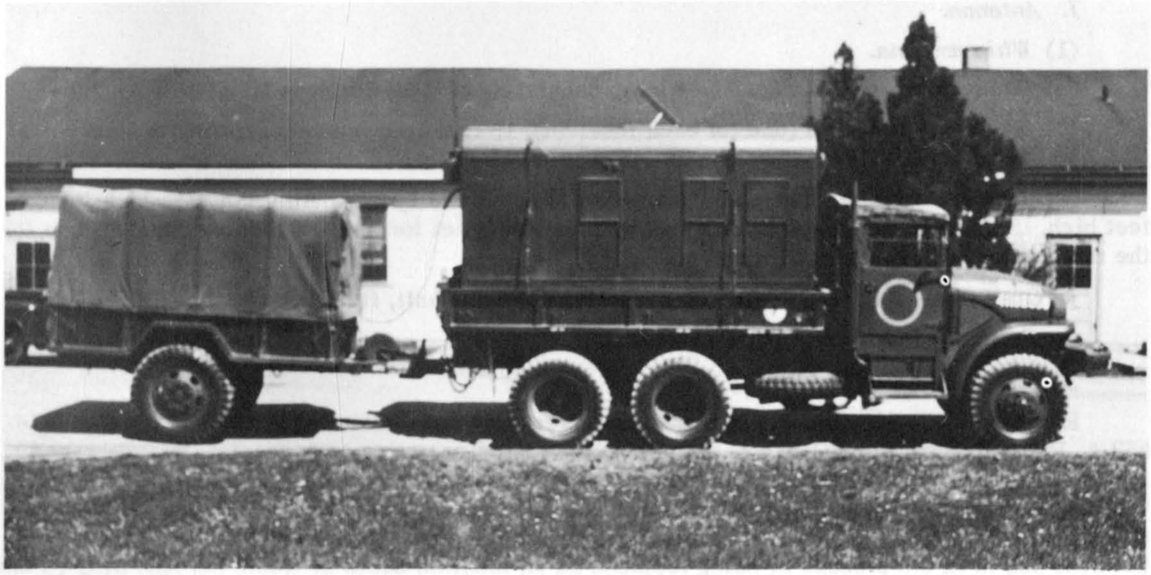


Figure 39. Radio Set AN/GRC-26A (exterior view).

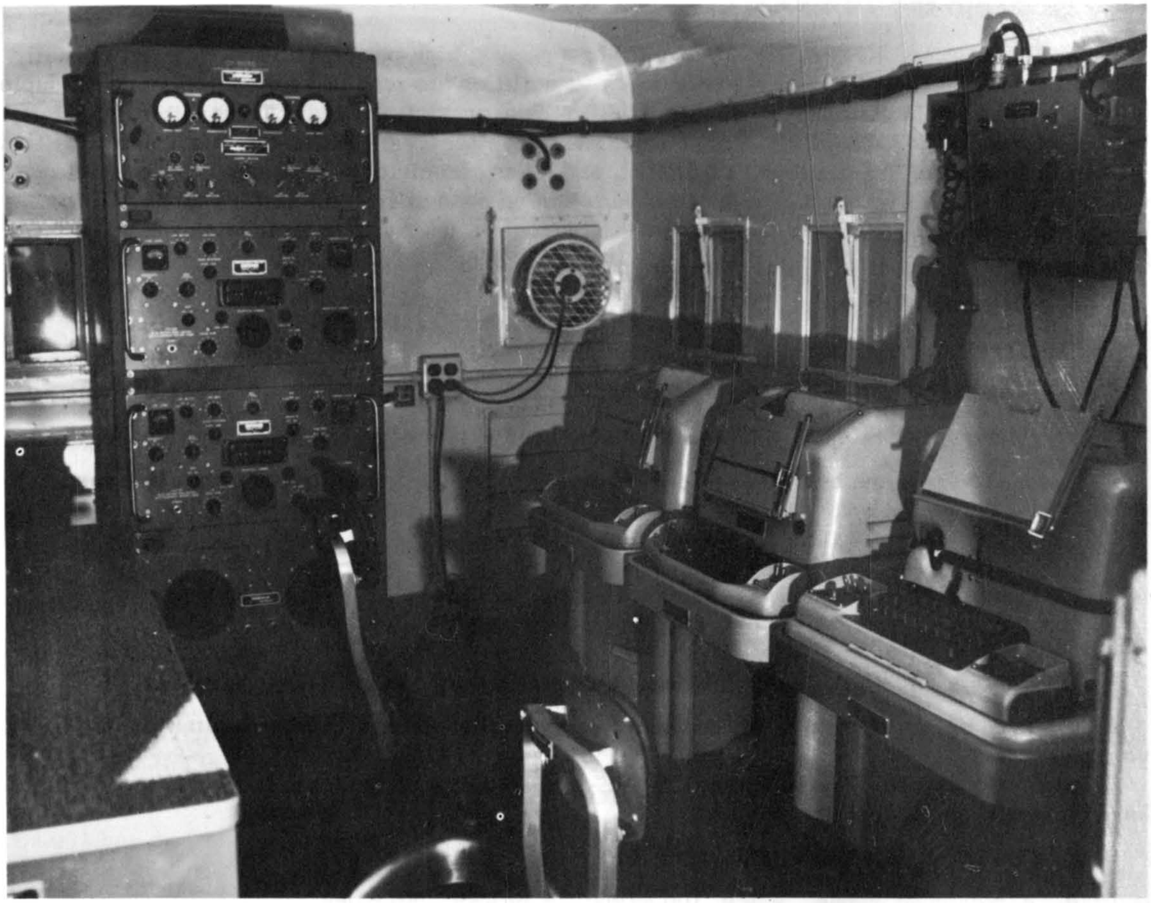


Figure 40. Radio Set AN/GRC-26A (interior view).

i. Antenna.

(1) *Whip antenna.*

(*a*) Transmitter—one each, 15 feet long, consisting of Mast Sections MS-49 through MS-53.

(*b*) Receiver—two each (one for each receiver), 15 feet long, each consisting of Mast Sections MS-116-A (3 each), MS-117-A, and MS-118-A.

(2) *Doublet antenna.* The doublet antenna is supported by Mast AB-155A/U, which is 40 feet high. Sufficient equipment is provided with the radio set for three of these antennas: one for the transmitter and one for each receiver.

j. Operation. May be operated as a mobile, mobile-at-halt, fixed, or semifixed station.

k. Pertinent Publication. TM 11-264A.

36. RADIO SET SCR-506

Radio Set SCR-506 (fig. 41) is a medium-power radio set consisting of Radio Receiver BC-652-A, Radio Transmitter BC-653-A, and other associated operating components. It is designed for installation in tracked and wheeled vehicles to provide CW and voice communication from one vehicle to another or between a vehicle and a base station. Radio Set SCR-506 formerly was used extensively throughout the armored division but is not authorized under current TOE. Radio Set SCR-506 is in the process of being replaced on an attrition basis by Radio Set AN/GRC-19 and Radioteletype Sets AN/VRC-29 and AN/GRC-46. However, it will be some time before complete replacement can be accomplished.

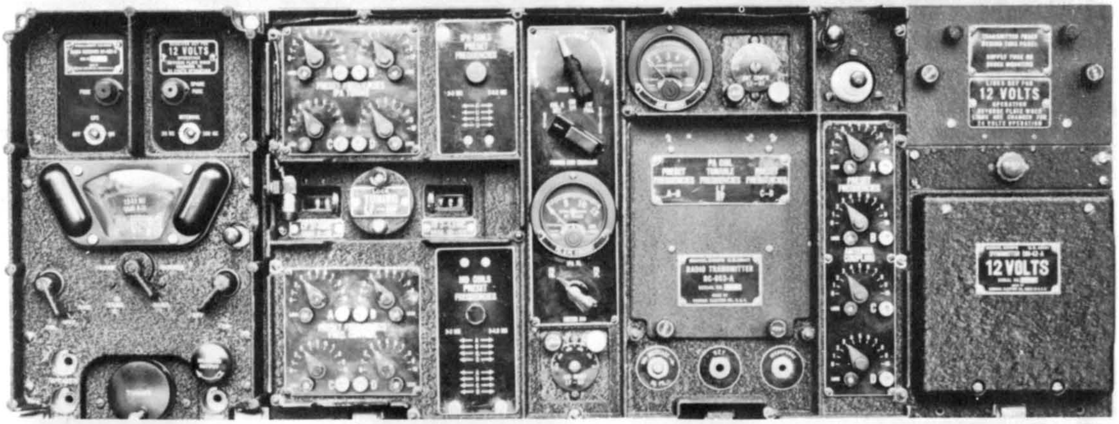


Figure 41. Radio Set SCR-506.

a. *Frequency Range.*

(1) Transmitter–2.0 to 4.5 mc.

(2) Receiver–2.0 to 6.0 mc (in two bands).

b. *Number of Crystals.* One (for calibration only).

c. *Type of Tuning.*

(1) Transmitter–four preset and one tunable channel.

(2) Receiver–continuously tunable.

d. *Calibration.* Built-in calibration check points in the receiver at every 20-kc and 100-kc interval.

e. *Type of Signal.* CW or voice (amplitude modulated).

f. *Power Source.*

(1) Transmitter–12-volt vehicular battery through Dynamotor DM-42-A; 24-volt vehicular battery through Dynamotor DY-96/VRC.

(2) Receiver–12-volt vehicular battery through Dynamotor DM-40-A; 24-volt vehicular battery through Dynamotor DY-142/VRC.

g. *Power Output.* CW operation, 50 to 90 watts; voice operation, 10 to 25 watts, depending on frequency.

h. *Approximate Range.*

(1) CW–Stationary, 75 miles; moving, 35 miles.

(2) Voice–Stationary, 25 miles; moving, 15 miles.

i. *Antenna.*

(1) Whip antenna–15 feet long consisting of Mast Sections MS-116-A (3 each), MS-117-A, and MS-118-A.

(2) Extended whip antenna–25 feet long. Same as whip antenna except that additional Mast Sections MS-116-A are added.

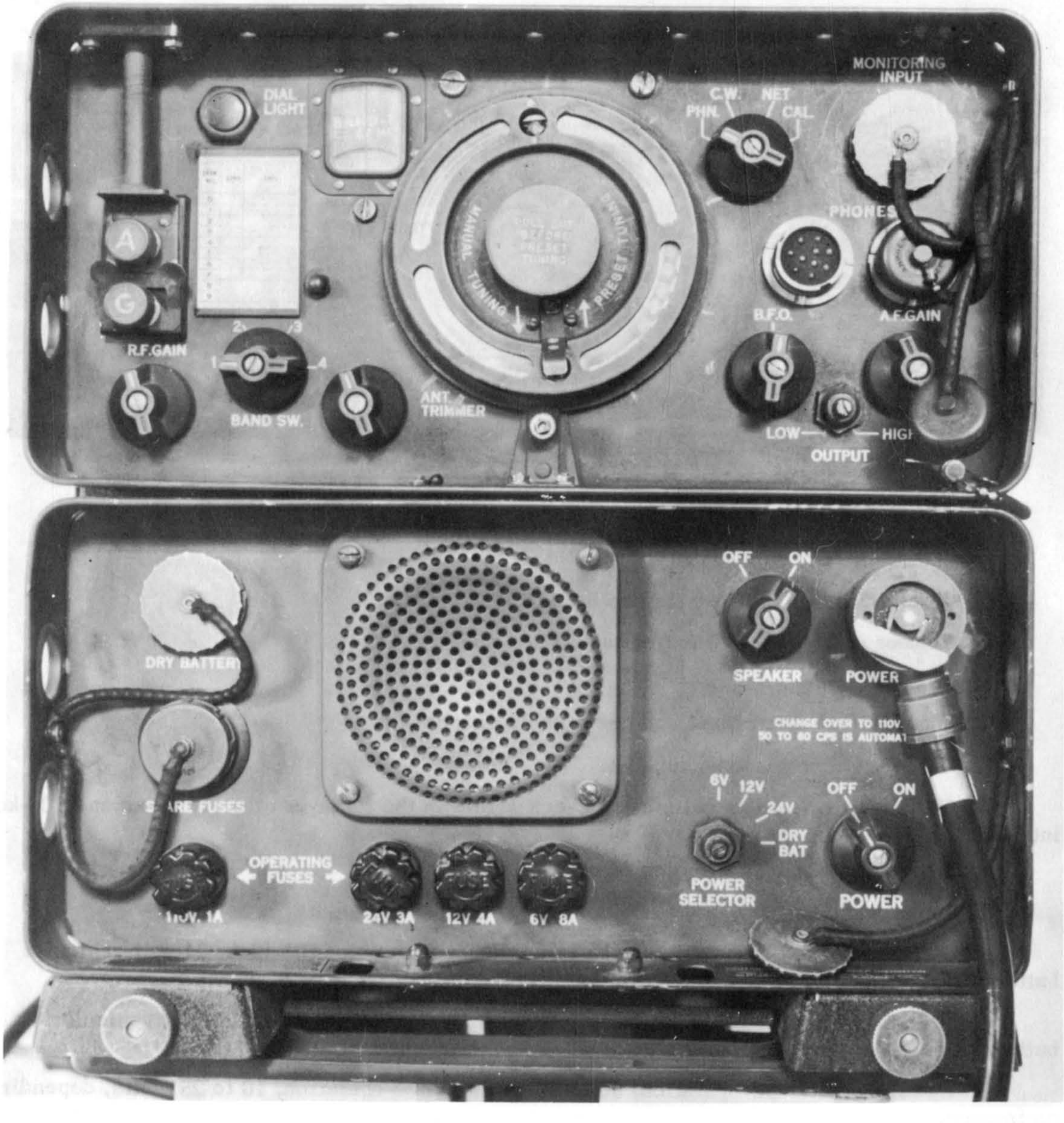


Figure 42. Radio Set AN/GRR-5.

37. RADIO SET AN/GRR-5

Radio Set AN/GRR-5 (fig. 42) is a mobile radio receiver used throughout the armored division to monitor the division warning net AM. The receiver provides facilities for operation either with a loud-speaker contained within the unit, or with a headset. Radio Set AN/GRR-5 consists of Radio Receiver R-174/URR, Power Supply PP-308/URR, and associated components. The radio set can be used alone as a conventional receiver, or with an appropriate AM transmitter in a particular communication system.

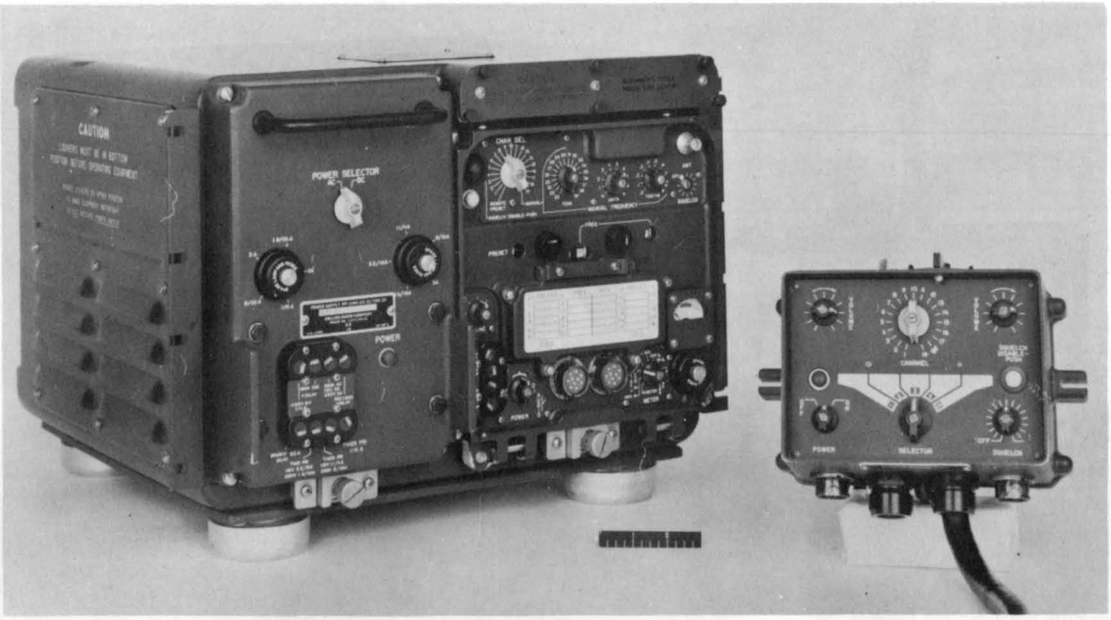


Figure 43. Radio Set AN/VRC-24(XC-2). (Service-Test Model.) Mfr. Collins Radio Co. Front ¾ View. Showing Receiver-Transmitter RT-323(XC-2)/VRC-24, Power Supply PP-1494(XC-2)/VRC-24, Installed in Case CY-1972(XC-2)/VRC-24 and Control C-1439(XC-2)/VRC-24.

38. RADIO SET AN/VRC-24

Radio Set AN/VRC-24 (fig. 43) replaces Radio Set AN/ARC-27. Radio Set AN/VRC-24 is an air-to-ground radio set and can be mounted in either a tracked or wheeled vehicle. Radio Set AN/VRC-24 is to be used primarily by forward air controllers operating in the tactical air direction net. It will be installed with the AN/GRC-3 through -8 series and provides automatic retransmission over these sets. It will also be used with proposed Radio Set AN/VRC-12. Radio Set AN/VRC-24 consists of a receiver and transmitter, RT-323/VRC-24, Mounting Base MT-1436/VRC-24, and control C-1439/VRC-24, with 1750 channels available for communication. Radio Set AN/VRC-24 can be found throughout the armored division down to and including combat battalion level.

a. Frequency Range. 225.0 to 399.9 mc.

b. Number of Channels. 1,750.

c. Type of Tuning. 20 preset channels, plus manual.

d. Calibration. Crystal controlled.

e. Type of Signal. Voice (amplitude modulated).

f. Power Source. 24-volt vehicle battery through a dynamotor power supply within the set.

g. Power Output. 2 to 20 watts.

h. Approximate Range. 30 miles at a 100-foot elevation; 35 miles at a 1,000-foot elevation; 100 miles at a 10,000-foot elevation.

i. Antenna. ¼-wave type.

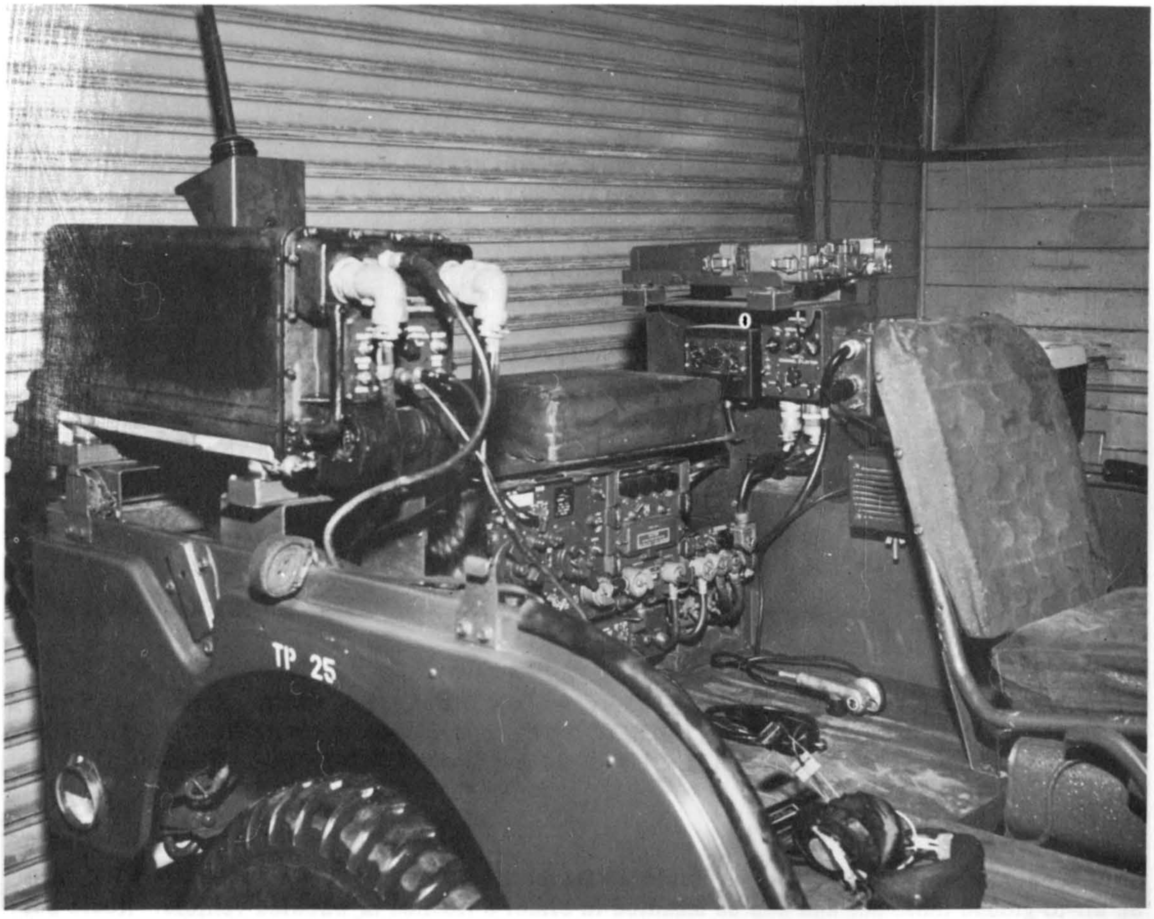


Figure 44. Radio Set AN/VRC-30.

39. RADIO SET AN/VRC-30

a. Radio Set AN/VRC-30 (fig. 44) is a VHF-UHF ground-to-air radio set that is to replace Radio Set AN/MRC-20. The primary use of the AN/VRC-30, like the AN/MRC-20, is to provide ground-to-air communication for air liaison officers and forward air controllers operating with armor units. Radio Set AN/VRC-30 consists of the following major components mounted in a ¼-ton truck:

(1) AN/ARC-27–UHF, 225.0 to 399.9 mc; AM, voice range 150 miles between aircraft at 30,000 feet.

(2) AN/PRC-9–HF and VHF, 27.0 to 38.9 mc; FM, voice range 5 miles with long antenna.

(3) AN/VRC-14–HF and VHF, 27.0 to 38.9 mc; FM, voice range approximately 10 miles moving, 15 miles stationary.

(4) AN/TRC-7–VHF, 100.0 to 156.0 mc; AM voice, power output 0.5 to 1.5 watts.

Notes. 1. This radio set is optional with Radio Set AN/VRC-30.

2. Radio Set AN/ARC-27 is being replaced by Radio Set AN/VRC-24. The characteristics of the 2 sets are the same.

b. The forward air controller can contact tactical aircraft when dismounted. He transmits with his AN/PRC-9 to the AN/VRC-14 which automatically retransmits through the AN/ARC-27.

Section VII. PREVENTIVE MAINTENANCE

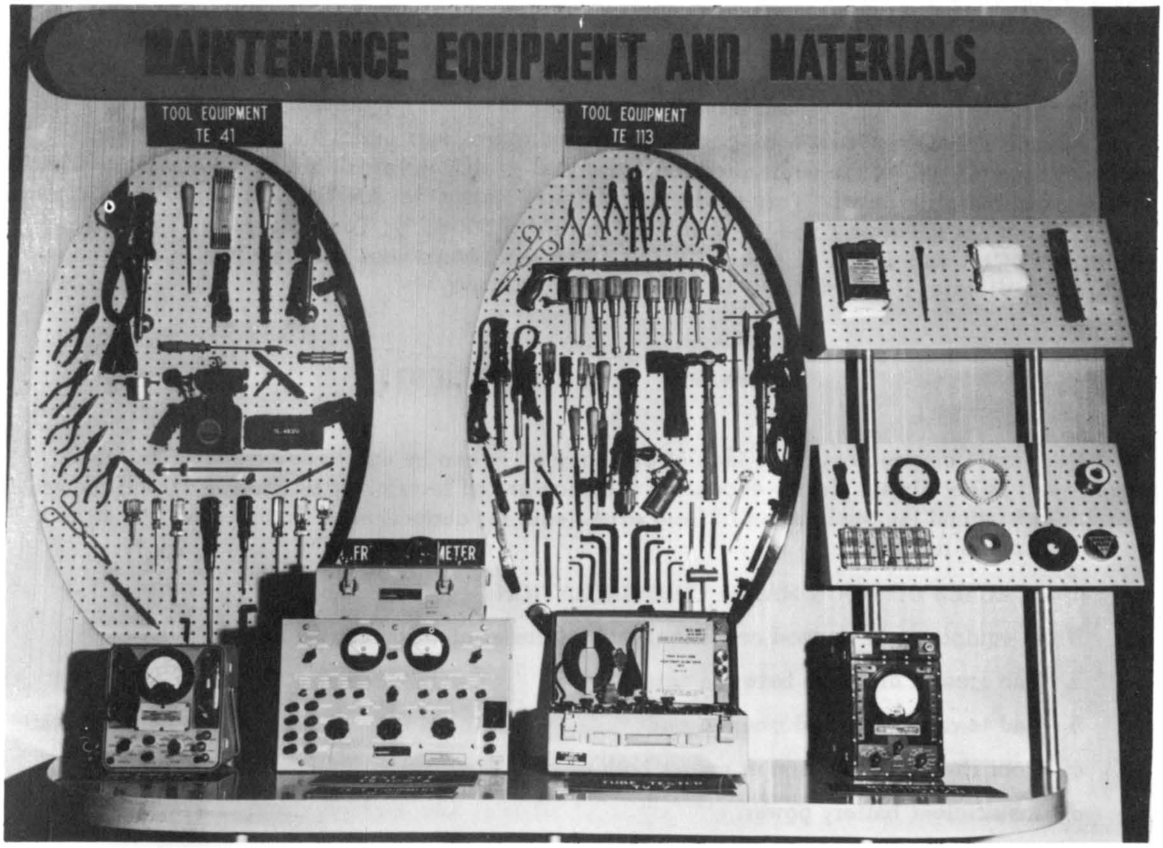


Figure 45. Maintenance equipment and materials.

40. GENERAL

Preventive maintenance is the care and servicing of equipment by user personnel in order to maintain it in a satisfactory operating condition. This requires systematic frequent inspections for the detection and correction of early-stage troubles either before they occur or before they develop into major defects. Preventive maintenance is the combination of all activities performed by the using organization to keep equipment in the best possible condition to stop failures before they start.

Preventive maintenance is the heart and soul of the entire maintenance system.

41. RESPONSIBILITY

Commanders are responsible for the maintenance of all communication equipment. They are responsible for instructions and directives that indicate correct preventive maintenance procedures. Further, commanders are responsible for training, and for ensuring that personnel have sufficient time to perform preventive maintenance. Commanders must also ensure that all communication equipment is maintained in a serviceable condition, is properly used and cared for, and that personnel comply with technical instructions. It must be emphasized continually that preventive maintenance is every soldier's job.

42. PREVENTIVE MAINTENANCE INSPECTIONS

Commanding officers will conduct preventive maintenance inspections on signal equipment, and will ensure that the appropriate DA forms are completed by the first- and second-echelon maintenance personnel in accordance with AR 750-625. DA check lists are valuable aids in performing preventive maintenance and inspections of signal equipment, and also aid in determining the deficiencies and state of combat readiness of the various categories of signal equipment. The preventive maintenance indicator technique may be used by commanders to assist in determining the status of the units' preventive maintenance program.

43. TOOLS AND TEST EQUIPMENT

Adequate tools and test equipment are required to properly perform organizational maintenance. Figure 45 shows the authorized tools and test equipment available to the communication specialist at battalion level. This equipment includes Multimeter AN/URM-105(ME-77); Multimeter PRM-15; Test Set Electron Tube TV-7/U; Vibrator Pack PP-68/U; Tool Equipment TE-33; Tool Equipment TE-41 and Tool Equipment TE-113. The same equipment less the Tool Equipment TE-113 and Vibrator Pack PP-68/U is authorized at company level.

Section VIII. FIELD EXPEDIENTS

44. GENERAL

Poor radio communication or lack of communication can be due to any one of a variety of reasons and is not always due to excessive distance or bad terrain. It is imperative that the radio operator understand the application of field expedients for correction or improvement of radio transmission and reception.

45. CAUSES OF POOR RADIO COMMUNICATION

If the equipment is in good condition, lack of communication can be caused by:

a. Too great a distance between sets.

b. Bad terrain—hills and mountains.

c. Poor choice of location at one or both ends of the circuit.

d. Insufficient battery power.

e. Noise and interference.

46. OPERATING HINTS

a. Use headset in place of a loud-speaker if the signal is weak. This will cut out local noise.

b. Be sure the microphone or handset is in good condition. Allow a few seconds for the transmitter tubes to warm up after pressing the PRESS-TO-TALK switch, then speak directly into the microphone. Speak slowly and distinctly.

c. If the set is in a vehicle, be sure the battery voltage is normal. Keep the engine running to charge the battery.

d. Movement of the antenna a few feet to a new location may improve reception.

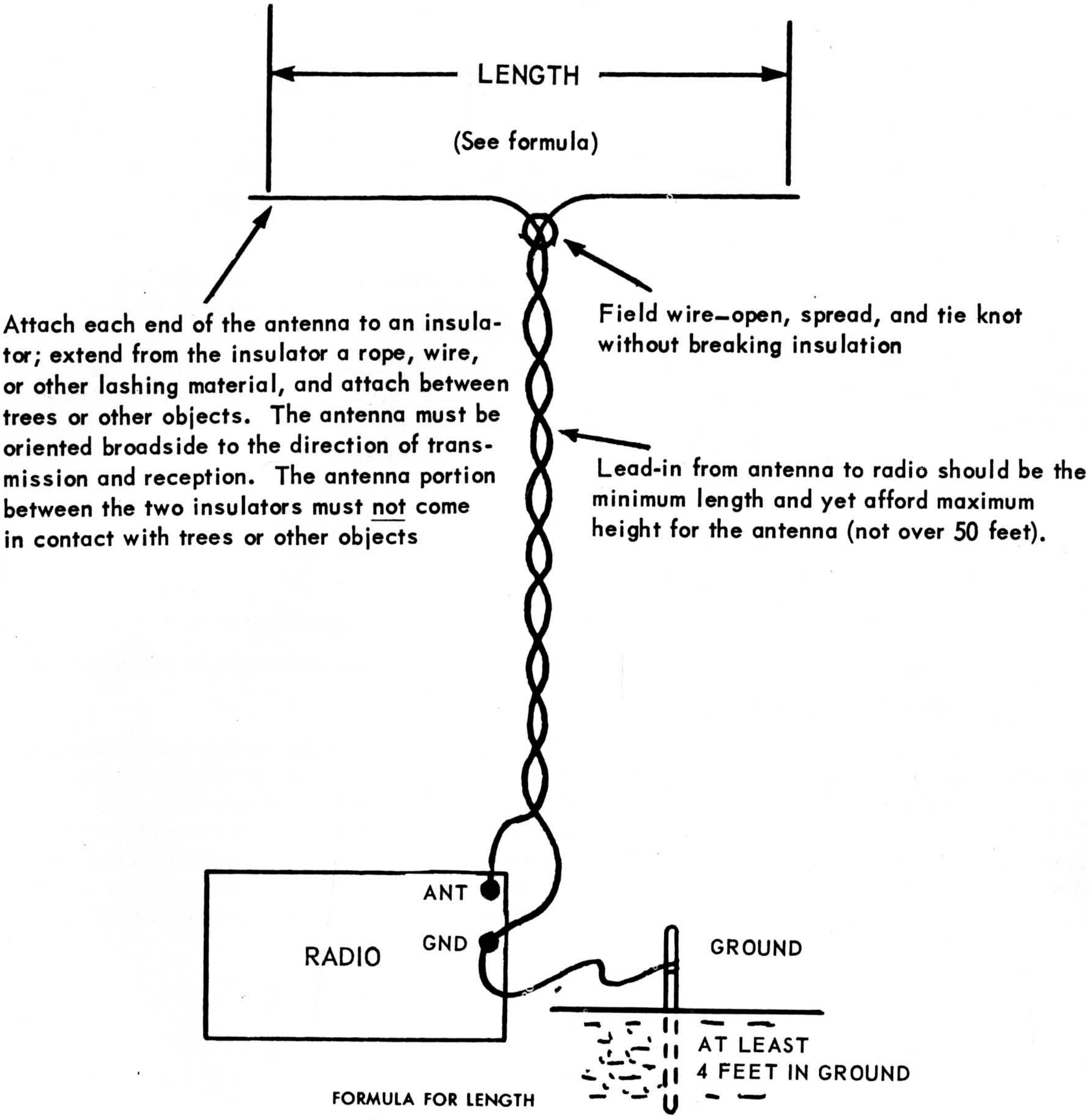
e. Use CW in place of voice for increased range on AM radios.

47. IMPROVISED ANTENNAS

a. Practically all of the radio sets in the combat areas use a whip-type antenna. This is the only type that can be used for vehicles and man-pack sets that must operate in motion. More detailed information on antennas can be found in the manual pertinent to the set being used, and TM 11-314.

b. Whip-type antennas may be broken in use; where replacements are not immediately available, it is possible to improvise a satisfactory antenna by use of field telephone wire.

c. When the situation does not require mobility, greater distance may be obtained with FM radios by use of Antenna Equipment RC-292 (fig. 29). In the same situation, an AM radio may be operated with the antenna illustrated in figure 46.



Attach each end of the antenna to an insulator; extend from the insulator a rope, wire, or other lashing material, and attach between trees or other objects. The antenna must be oriented broadside to the direction of transmission and reception. The antenna portion between the two insulators must not come in contact with trees or other objects

Field wire—open, spread, and tie knot without breaking insulation

Lead-in from antenna to radio should be the minimum length and yet afford maximum height for the antenna (not over 50 feet).

FORMULA FOR LENGTH

$$\text{Length (in feet)} = \frac{468}{\text{frequency (in mc)}}$$

EXAMPLE: What would be the length of an antenna for operation on 25 megacycles?

$$\text{LENGTH (IN FEET)} = \frac{468}{25} = 18.7 \text{ feet.}$$

Figure 46. Improvised antenna for sets operating between 20 and 60 mc.

Section IX. WIRE EQUIPMENT

48. GENERAL.

The use of wire in armor communication is not only desirable but also, under certain conditions, necessary. During periods of radio silence or enemy jamming activities, wire may become the primary means of communication. In rear areas, where there is a heavy load of administrative and logistical traffic, wire can be employed to a great advantage. Wire communication should be used in any situation where time permits its installation. Wire nets require more time to establish, are not as flexible, and are susceptible to disruption by enemy fire and by friendly troop and vehicular movement; however, wire nets are more secure and more reliable than are radio nets.

49. WIRE

Field wire is used for signal communication and is characterized by flexible conductors, high tensile strength, good conductivity, and weatherproof insulation. Field Wire WD-1/TT (fig. 47) is the type presently used by armor units. Wire WD-1/TT is an all-purpose, two-conductor field wire. It weighs 48 pounds per mile and has a tensile strength of 200 pounds maximum. Each conductor has three steel and four copper strands. The insulation is extruded polyethylene covered with a layer of extruded nylon. The communication range varies with the type of terminal equipment used. The approximate range is shown in the following.

a. Sound-powered telephones—5 miles.

b. Battery-powered telephones—up to 22 miles.

c. Amplifier-powered telephones—up to 44 miles.

d. Teletypewriter (DC)—up to 25 miles, by use of present equipment at 60 words per minute.

e. Teletypewriter (VF)—up to 15 miles, by use of present equipment at 60 words per minute.

50. WIRE SPLICING TOOL, TL-582/U

The Wire Splicing Tool, TL-582/U is a manually operated, magazine-fed, mechanical crimping tool which makes a splice in Wire WD-1/TT without the use of tapes or other tools (fig. 48). A wirecutter and stripper are built into one handle. The bare ends of the wire are inserted into the jaws of the device and the handles are closed. A ratchet is employed which prevents the wireman from making a weak splice. The closing of the jaws crimps a cartridge on the line thereby making and insulating the splice. These cartridges are fed from a magazine, and each cartridge is made up of three sleeves of tin, copper, and plastic. The tool weighs approximately 5 pounds.

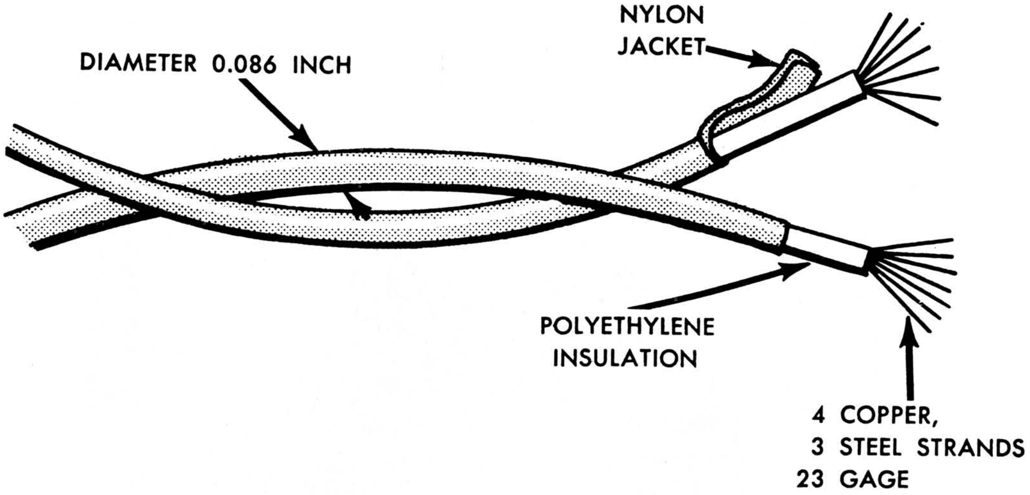


Figure 47. Field Wire WD-1/TT.

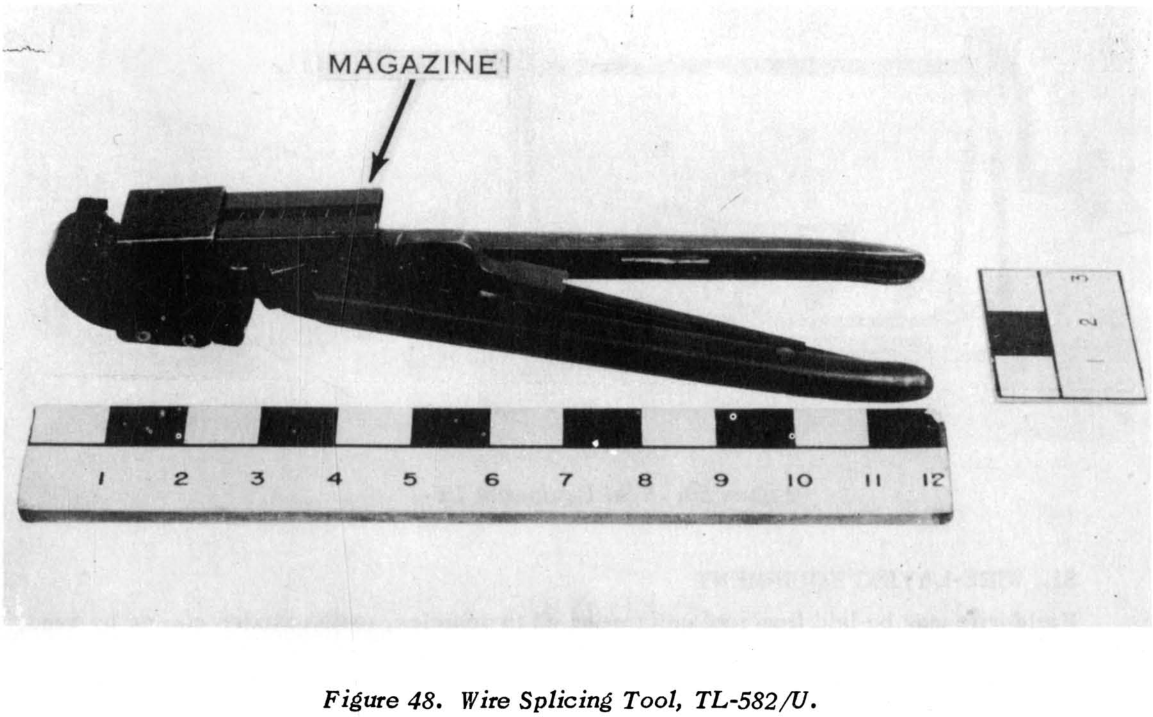


Figure 48. Wire Splicing Tool, TL-582/U.

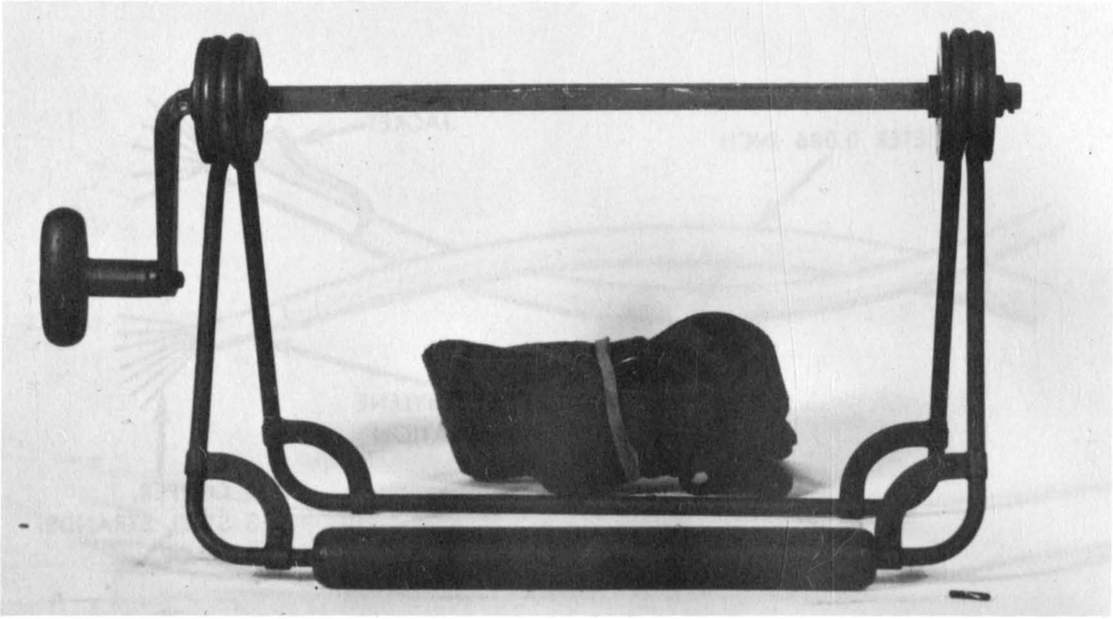


Figure 49. Reel Unit RL-39.

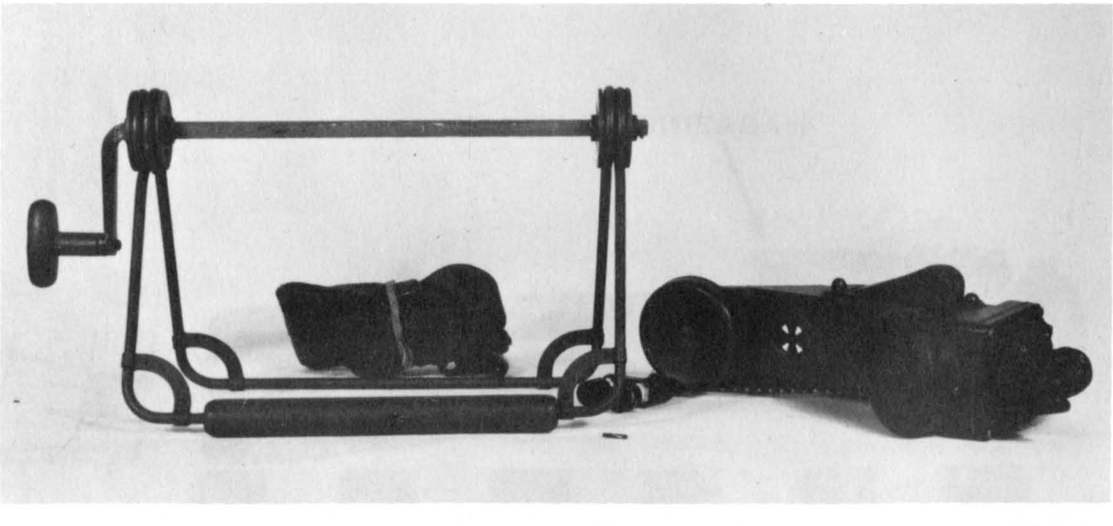


Figure 50. Reel Equipment CE-11.

51. WIRE-LAYING EQUIPMENT

Field wire may be laid from reel units mounted in vehicles, reels or axles carried by hand, reels or dispensers carried by hand, dispensers mounted on aircraft or vehicles, and dispensers by use of rockets or similar projectiles. Wire-laying equipment organic to armor units includes:

a. *Reel Equipments RL-39 and CE-11.* Reel Equipment RL-39 consists of crank, frame, and carrying straps (fig. 49). Reel Equipment CE-11 includes the RL-39 complete, plus a sound-powered telephone TA-1/PT, and carrying straps (fig. 50). Both items are for the laying or recovery of wire by means of a Spool DR-8 which holds ¼ mile of wire of type WD-1/TT.

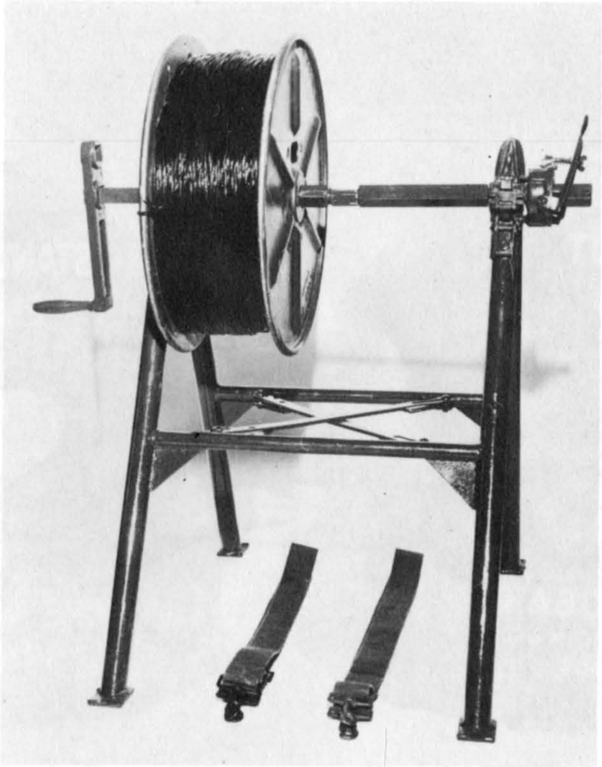


Figure 51. Reel Unit RL-31-( ). Holds one or two Reels RL-159/U.

b. Reel Unit RL-31-( ). This is a rugged, lightweight, portable unit designed to facilitate laying and recovering field wire and field cable. The reel unit (less wire) weighs about 46 pounds. It may be mounted in a vehicle or hand-carried. The frame may be adjusted to the form of an A-frame, a stretcher (two men required), or wheelbarrow. The reel RL-159/U holds 1 mile of Wire WD-1/TT. The unit consists of a frame, divided axle, two brake units, crank, carrying straps, and toe plates.

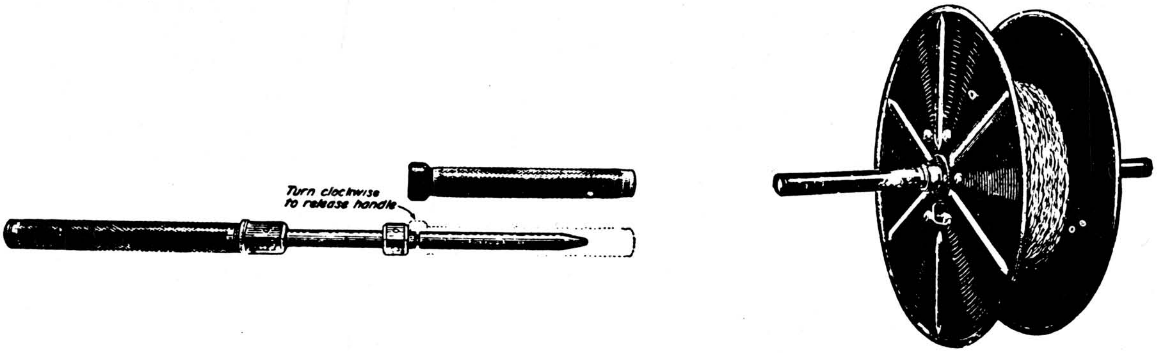

Turn clockwise to release handle

Figure 52. Axle RL-27-( ), showing the removable handle, and Reel RL-159.

c. Axle RL-27-( ). This device consists of an axle about 2 feet long with two knurled handles; one handle is permanently fixed to the bar, the other can be removed to permit the placing of Reel 159/U on the axle (fig. 52). Axle RL-27 is used for laying short field wire circuits by hand. Later models of Axle RL-27 are equipped with a crank which is used to recover wire.

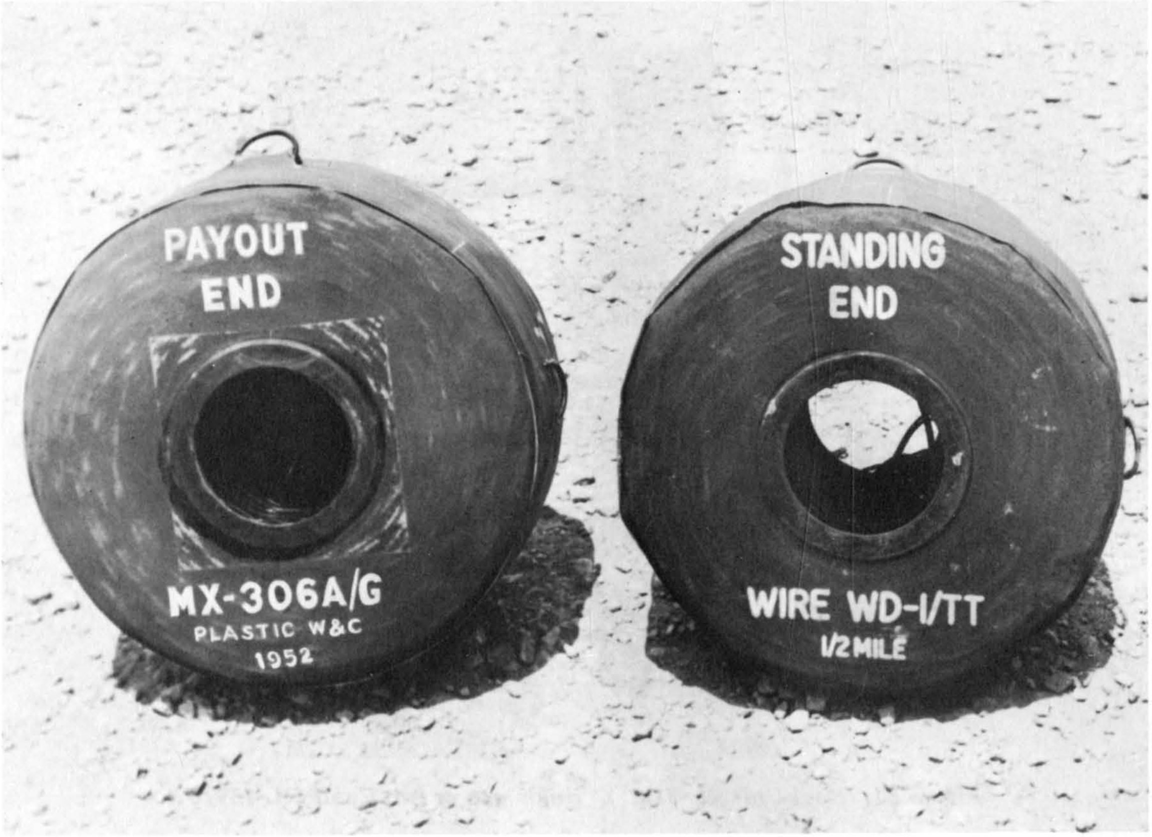
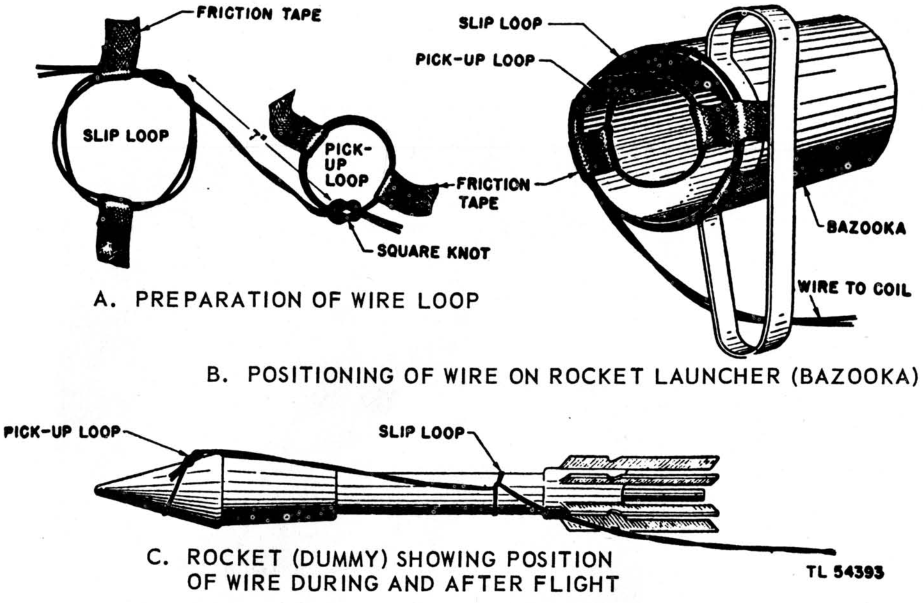


Figure 53. Wire Dispenser MX-306A/G.

d. Wire Dispenser MX-306A/G. Wire WD-1/TT is coil wound in expendable dispensers (fig. 53) which are suitable for laying from packboard (fig. 56) or from Army aircraft (fig. 57). Wire can also be laid from a hand-carried or vehicle-mounted dispenser. Wire Dispenser MX-306A/G, with ½ mile of Wire WD-1/TT, is 14 inches in diameter with a 4-inch hole, and may be used where the heavier pack will not interfere with operations. The 3.5-inch rocket launcher may be used for laying wire from wire dispensers (fig. 54). A rifle grenade may also be used in emergencies to lay wire from these dispensers (fig. 55).

Caution. Keep personnel away from wire being paid out. Use dummy rocket launcher ammunition and dummy rifle grenades.



A. PREPARATION OF WIRE LOOP

B. POSITIONING OF WIRE ON ROCKET LAUNCHER (BAZOOKA)

C. ROCKET (DUMMY) SHOWING POSITION OF WIRE DURING AND AFTER FLIGHT

Figure 54. Steps in the use of rocket launcher (bazooka) and dummy projectiles to lay wire from Dispenser MX-306A/G.

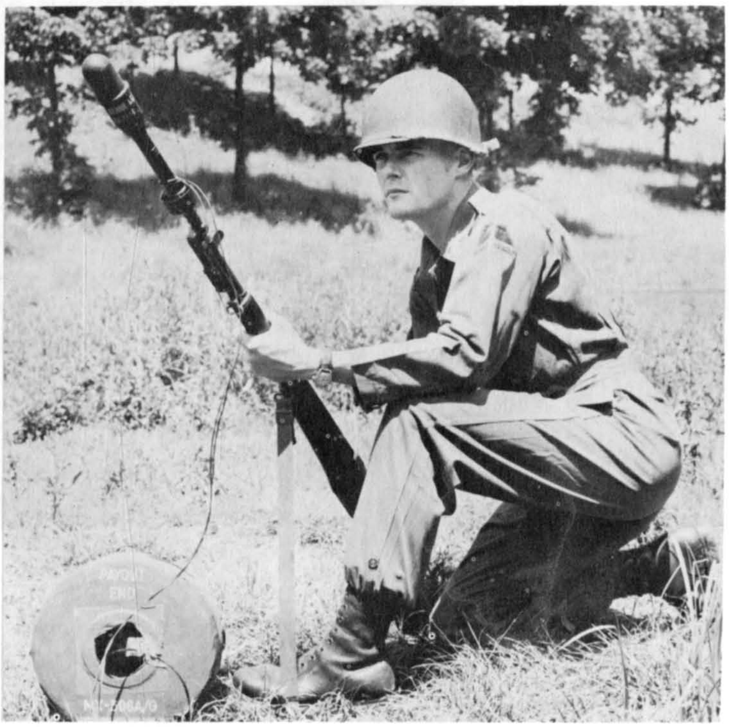


Figure 55. Use of dummy rifle grenade to lay wire from Dispenser MX-306A/G.

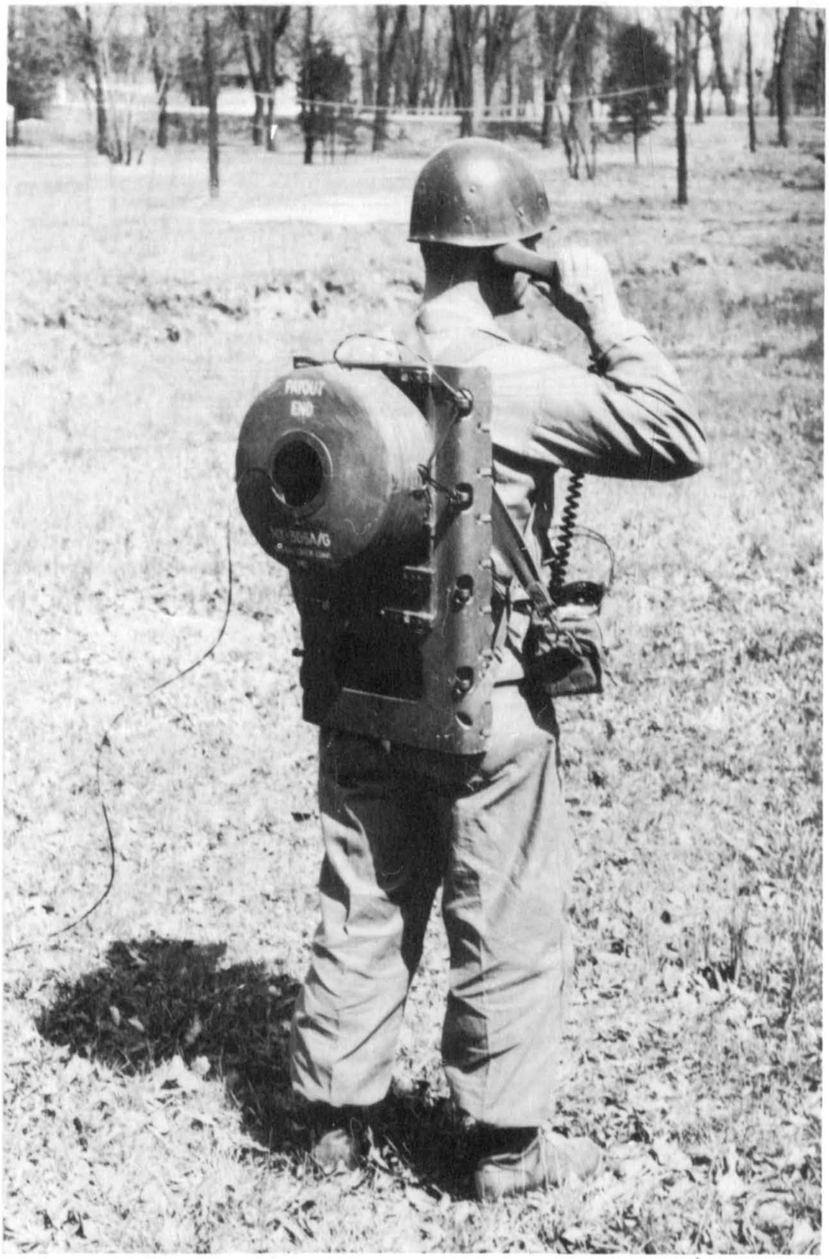
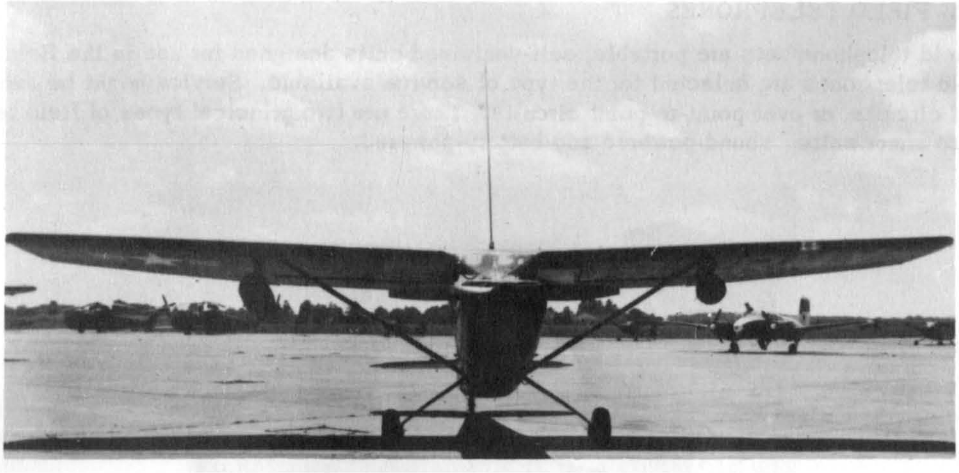


Figure 56. Wire Dispenser MX-306A/G lashed to packboard.



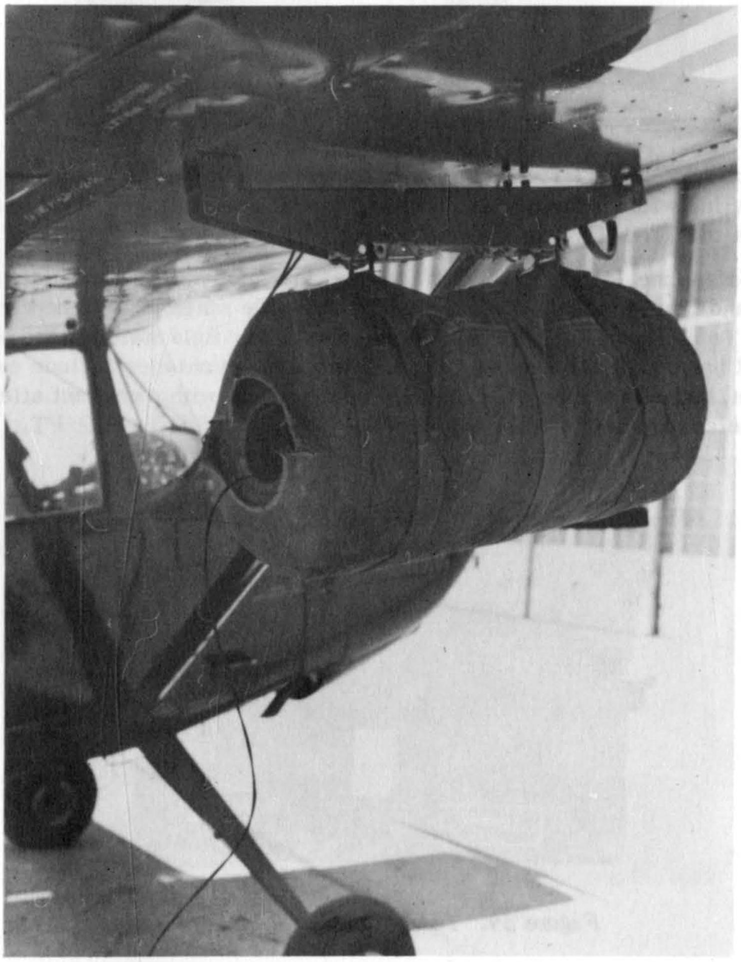


Figure 57. Wire Dispenser MX-306A/G and containers mounted under the wings of Army aircraft.

52. FIELD TELEPHONES

Field telephone sets are portable, self-contained units designed for use in the field. Specific field telephones are selected for the type of service available. Service might be over switched circuits, or over point-to-point circuits. There are two principal types of field telephones organic to armor units: sound-powered and battery-powered.

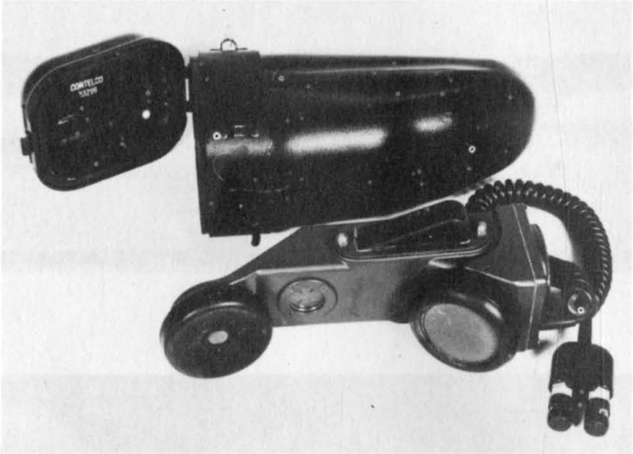


Figure 58. Telephone Set TA-1/PT.

a. *Telephone Set TA-1/PT.* This is a complete sound-powered telephone in handset form. Talking and signaling without the use of batteries can be accomplished over a distance of 5 miles by means of the TA-1/PT (fig. 58).

b. *Field Telephone TA-43/PT.* This is a portable, general-purpose field telephone. It is immersion proof and blast proof, and can withstand the wide range of service conditions imposed by military use. Telephone TA-43/PT may be used with any field switchboard and can operate in common and local battery installations. Other operational advantages include emergency sound-powered operation, and a new type of adjustable audio signal with excellent attention-attracting qualities. This telephone set is being replaced by Telephone Set TA-312/PT.

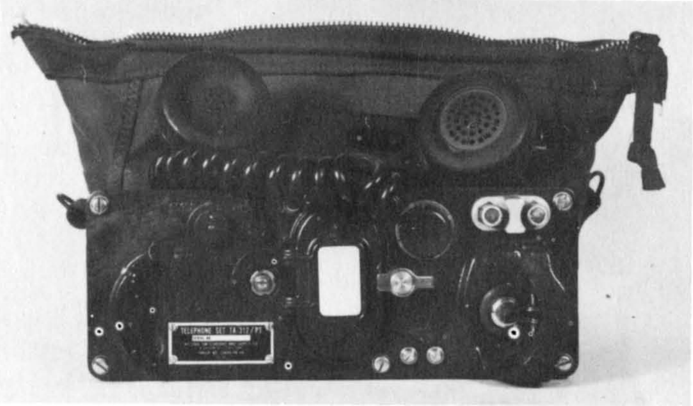


Figure 59. Telephone Set TA-312/PT.

c. *Telephone Set TA-312/PT.* This set is basically the same as and has all the provisions of Telephone Set TA-43/PT with the addition of Handset-Headset H-81/U. Talking distance when using Wire WD-1/TT is up to approximately 22 miles. Telephone Set TA-312/PT will replace Telephone Set TA-43/PT on an attrition basis. (Fig. 59.)

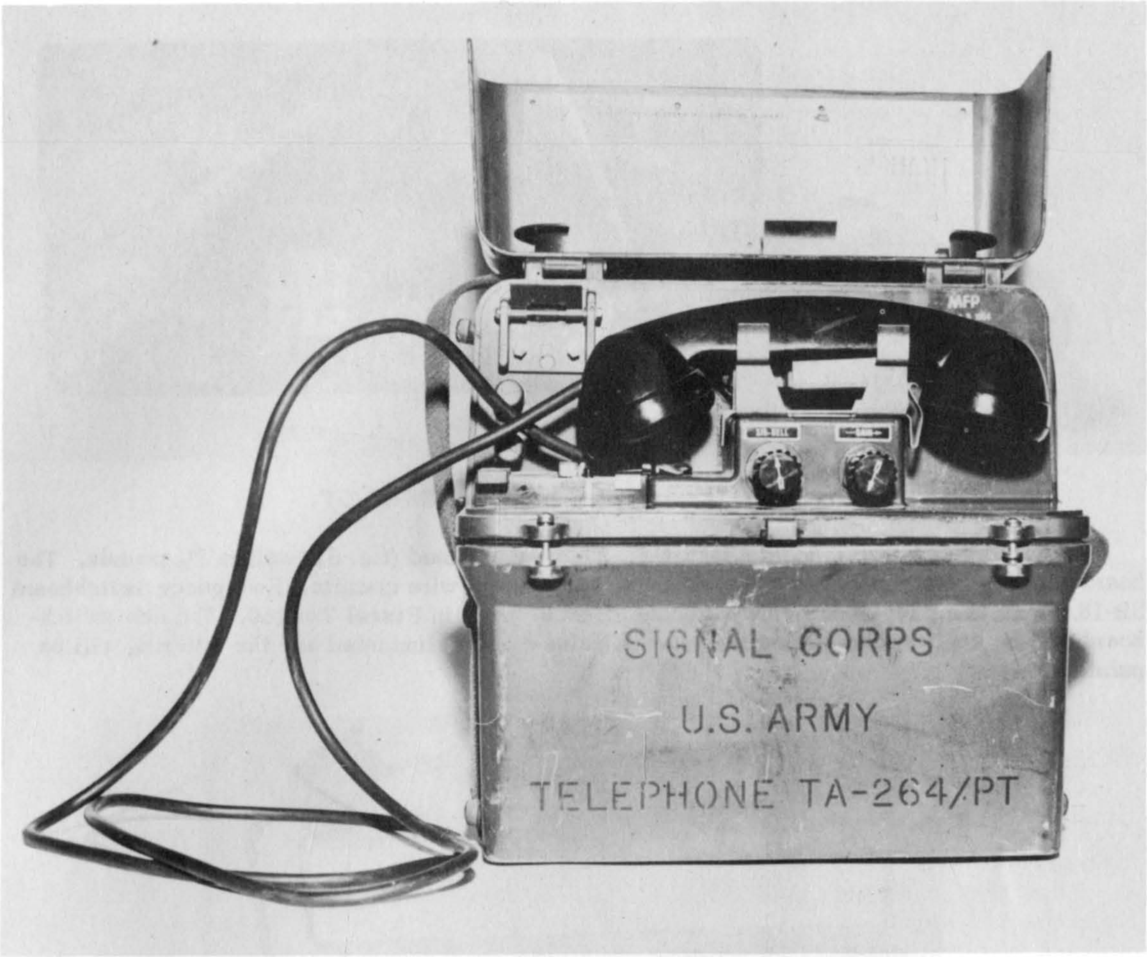


Figure 60. Telephone Set TA-264/PT.

d. Telephone Set TA-264/PT. This set uses batteries in conjunction with amplifying circuits to give two-way amplification for long-range wire communication (fig. 60). Talking distance for this set, by use of Wire WD-1/TT, is approximately 44 miles.

e. Sound-powered Handset TS-10. This handset is independent of external electrical power and has a maximum operating range of five miles. Handset TS-10 will operate with another Handset TS-10, a field telephone, or any field switchboard. Handset TS-10 was designed for use by units for short locals. It is being replaced by Telephone Set TA-1/PT.

53. TELEPHONE SWITCHBOARDS

The purpose of a switchboard is to add flexibility in a wire system by providing intercommunication between telephones and providing connections to trunk circuits leading to other units. Field switchboards are used in completing the netting of radio-wire integration systems. In armor units, 12-drop switchboards are used at combat command, battalion, and company level. Switchboards common to armor units are:

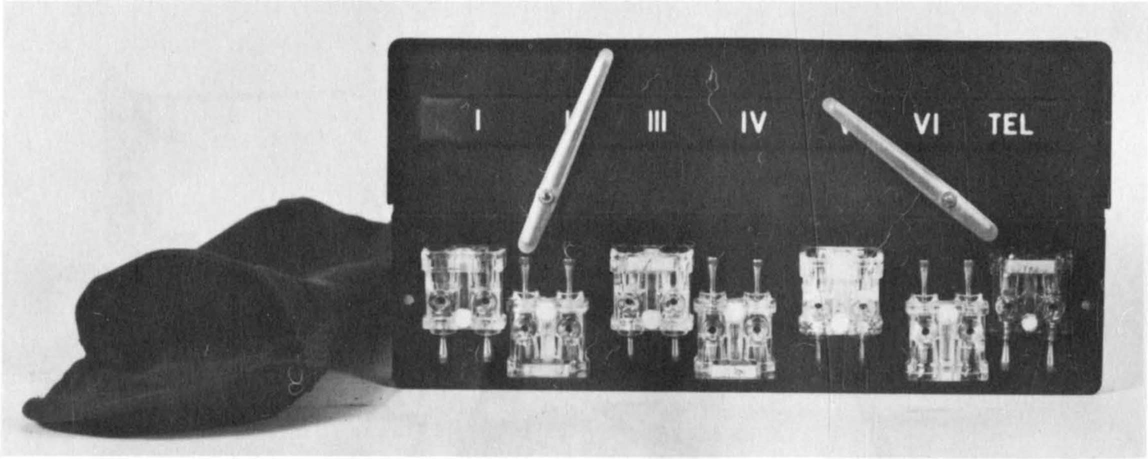


Figure 61. Emergency Switchboard SB-18/GT.

a. Emergency Switchboard SB-18/GT. This switchboard (fig. 61) weighs 2¼ pounds. The board will handle one operator's line and six local-battery wire circuits. Emergency Switchboard SB-18/PT is being replaced by Switchboard SB-993( )/GT in Fiscal Year 60. The new switchboard will be similar, except that the luminus paint will be eliminated and the lettering will be painted white.

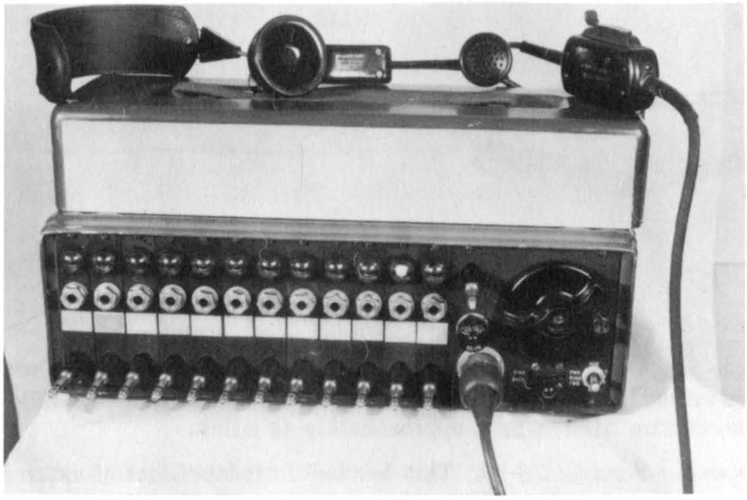


Figure 62. SB-22/PT (front view).

b. Switchboard SB-22/PT. This switchboard (fig. 62) weighs 35 pounds. It is a lightweight, 12-line, retractable-monocord type, local-battery (LB) switchboard designed to withstand the vibration and shock normally encountered under field conditions.

(1) Local and/or trunk and operator's circuits are contained in units which may be quickly replaced in the event of failure. The operator's circuit may be replaced by five line circuits, when stacking switchboards, to provide 17 lines in the second board or a total of 29 lines for two stacked switchboards (fig. 63).

(2) Facilities are provided for answering, ringing, and supervising on each line. Means also are provided for selection of an audible night alarm with or without an associated visual alarm.

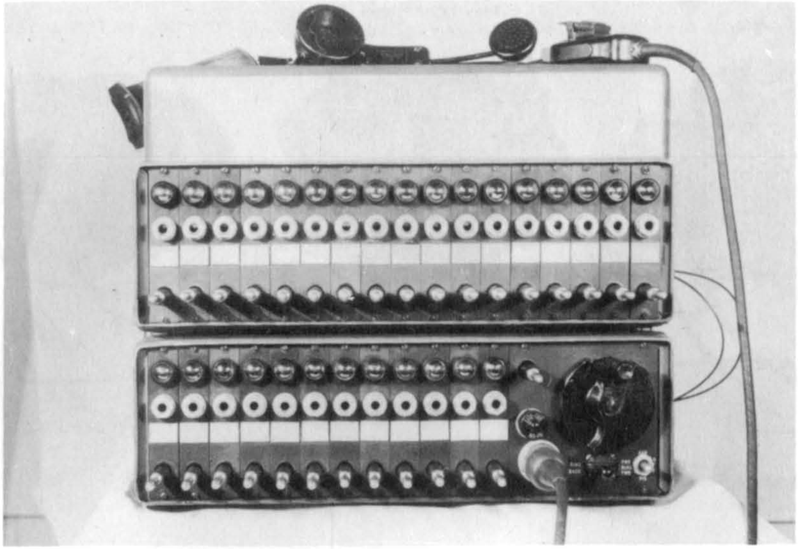


Figure 63. Two SB-22/PTs stacked for series operation (front view).

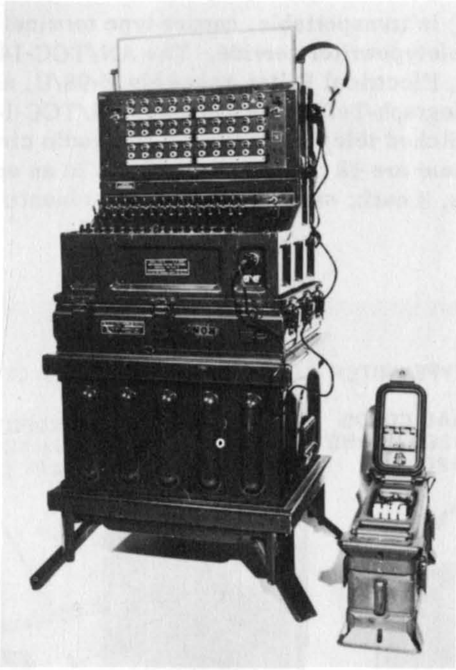


Figure 64. Switchboard SB-86( )/P.

c. *Switchboard SB-86( )/P.* This switchboard (fig. 64) is a portable, 30-line, retractable-cord type of field switchboard weighing 150 pounds. Switchboard SB-86( )/P contains an operator's circuit, 16 cord circuits, night alarm, and conference facilities; it will operate in either a common- or local-battery system. In addition, two lines are modified, permitting them to be used as trunk lines between the SB-86 and any commercial or other common-battery manual switchboard or central office set. When packed for transportation, the case is immersion proof. The SB-86 is found in the signal battalion and division artillery of the armored division, and also in the armored cavalry regiment.

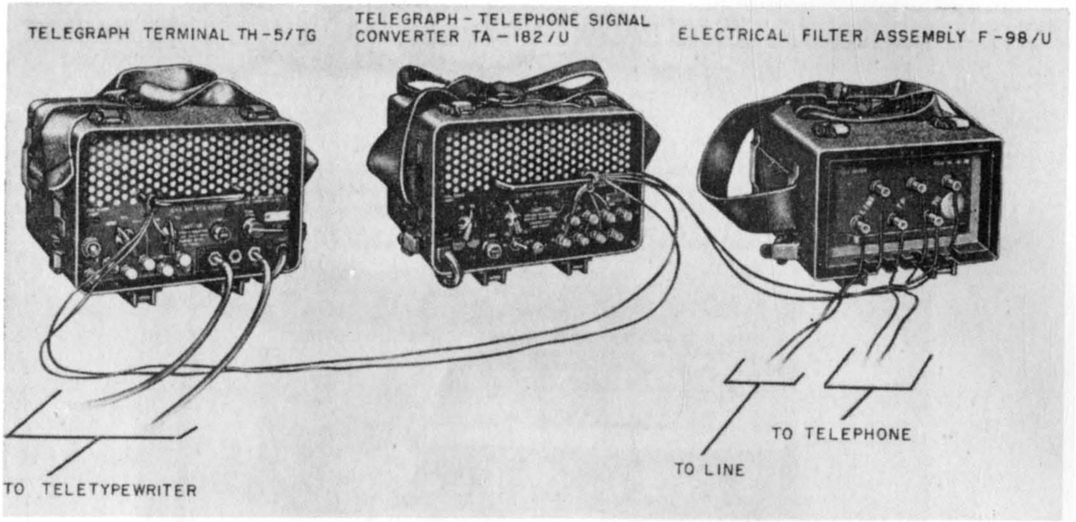

TELEGRAPH TERMINAL TH-5/TG
TELEGRAPH - TELEPHONE SIGNAL CONVERTER TA-182/U
ELECTRICAL FILTER ASSEMBLY F-98/U
TO TELETYPEWRITER
TO LINE
TO TELEPHONE

Figure 65. Telegraph-Telephone Terminal AN/TCC-14.

54. TELEGRAPH-TELEPHONE TERMINAL AN/TCC-14

This equipment (fig. 65) is transportable, carrier-type terminal equipment that provides simultaneous telephone and teletypewriter service. The AN/TCC-14 consists of three components: Telegraph Terminal TH-5/TG, Electrical Filter Assembly F-98/U, and Telegraph-Telephone Signal Converter TA-182/U. Telegraph-Telephone Terminal AN/TCC-14 can be used in point-to-point circuits, network circuits, switched telephone circuits, and radio circuits. For detailed information, refer to TM 11-2239. There are 18 of these equipments in an armored division distribution as follows: combat commands, 3 each; signal battalion, 5; ordnance battalion, 4.

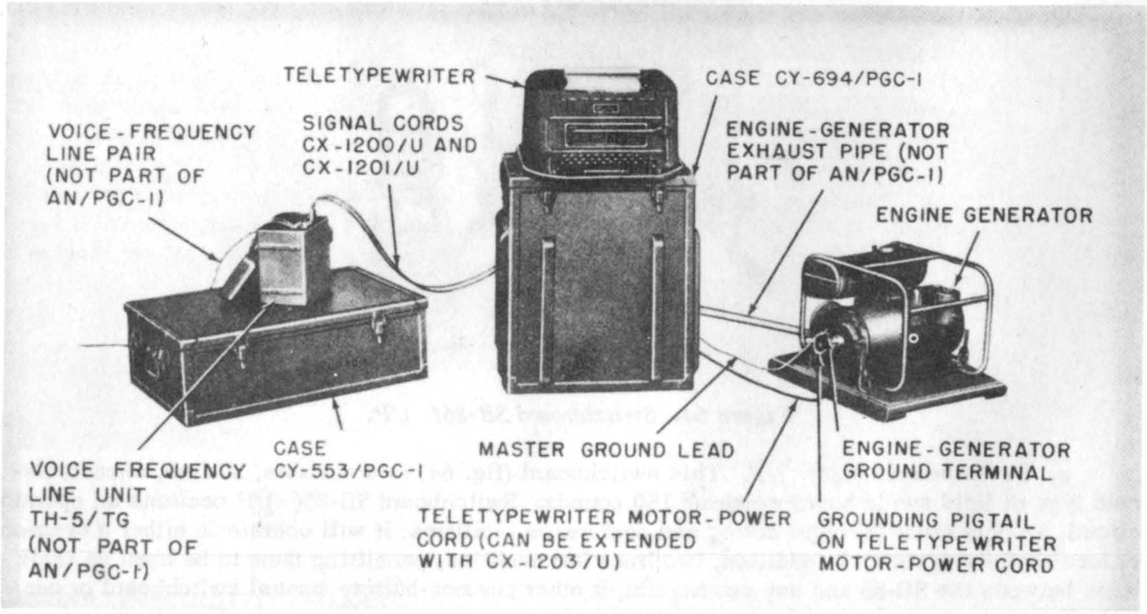

TELETYPEWRITER
CASE CY-694/PGC-1
VOICE-FREQUENCY LINE PAIR (NOT PART OF AN/PGC-1)
SIGNAL CORDS CX-1200/U AND CX-1201/U
ENGINE-GENERATOR EXHAUST PIPE (NOT PART OF AN/PGC-1)
ENGINE GENERATOR
CASE CY-553/PGC-1
MASTER GROUND LEAD
ENGINE-GENERATOR GROUND TERMINAL
VOICE FREQUENCY LINE UNIT TH-5/TG (NOT PART OF AN/PGC-1)
TELETYPEWRITER MOTOR-POWER CORD (CAN BE EXTENDED WITH CX-1203/U)
GROUNDING PIGTAIL ON TELETYPEWRITER MOTOR-POWER CORD

Figure 66. Teletypewriter Set AN/PGC-1.

55. TELETYPEWRITER SET AN/PGC-1

This is a lightweight, portable, sending and receiving teletypewriter station primarily intended for field use, and may be found in the combat command and division headquarters of the armored division. The components of Teletypewriter Set AN/PGC-1 include a standard communication teletypewriter (TT-4/TG), a gasoline engine AC generator (PU-181/PGC-1), and a case of accessories (CY-553/PGC-1). See figure 66.

Section X. VISUAL, SOUND, AND MESSENGER COMMUNICATION

56. SUPPLEMENTARY MEANS OF COMMUNICATION

Under adverse conditions or in certain tactical situations, radio, the primary means of communication in armor, must be supplemented or even replaced. This is accomplished by utilization of all available supplementary means of communication. These means are visual, sound, wire, and messenger. In this section, only visual, sound, and messenger are discussed, since wire is discussed in section IX.

57. VISUAL COMMUNICATION

a. Visual communication is widely used within armor units.

b. Visual means of communication used in armor units include:

(1) *Flags.* Flag sets are issued to all crew-served combat vehicles and consist of three individual flags—orange, green, and red. For methods of employment, see FM 21-60, section III.

(2) *Lights.* Flashlights or signal lamps are used during hours of darkness to send short prearranged messages. (See FM 21-60, figs. 49-53.)

(3) *Pyrotechnics.* Pyrotechnics for signaling purposes are found in ammunition basic loads. Prearranged meanings for these are found in the unit SOI. Pyrotechnics are easily copied by the enemy. Little reliance can therefore be placed on them, unless their source or origin can be definitely identified. The originator of such signals has no method of determining whether the signal has been observed by the person or unit for whom it is intended. For general information and description, see FM 21-60, section IV.

(4) *Panels.* Two general types of panels are issued to armor units for communication with aircraft.

(*a*) *Panel Marker VS-17GVX.* This panel marker is issued to each armor combat vehicle and consists of one panel, 72 inches long by 24 inches wide. One side of the panel is yellow and the reverse side is red. The colored sides of this panel have a fluorescent effect under moonlight. This panel is used to mark vehicles or front lines for friendly aircraft or other ground troops. Vehicular and troop identification displays normally change daily as prescribed in the unit SOI. This panel may also be used to mark drop zones for aerial resupply. (Panel Set AP-50 is a similar older type panel set that may be issued in lieu of Panel Set VS-17 GVX.)

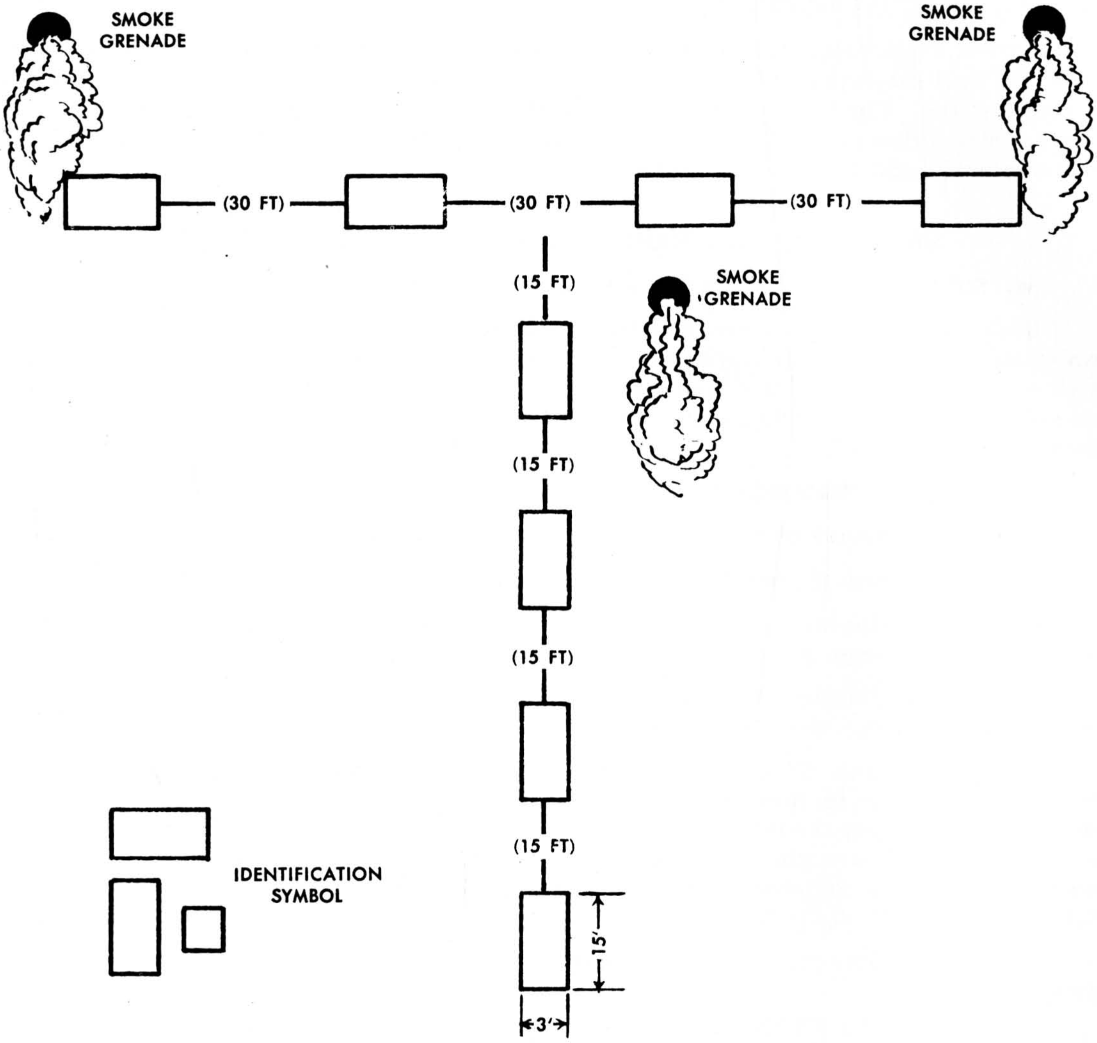


Figure 67. Marking of drop zone.

1. Panel Sets VS-17/GVX and AP-50 may be used for marking drop zones. See figure 67 for typical method of marking of drop zone.
2. Panel Sets VS-17/GVX and AP-50 may be used for marking helicopter landing sites. See figure 68 for typical marking of helicopter landing sites.

(*b*) *Panel Sets AP-30 C and D.* Panel Set AP-30 C consists of 13 black and AP-30 D consists of 13 white cotton panels, each 12 feet long by 2-1/3 feet wide, with suitable pins for fastening to the ground. They are used for sending short prearranged messages to aircraft, and in marking drop zones. For prearranged meanings see FM 21-60, section V, and unit SOI.

(5) *Arm and hand signals.* These signals are used in armor for the control of small-unit actions and in the control and movement of vehicles. See FM 21-60, section II, figures 37-53.

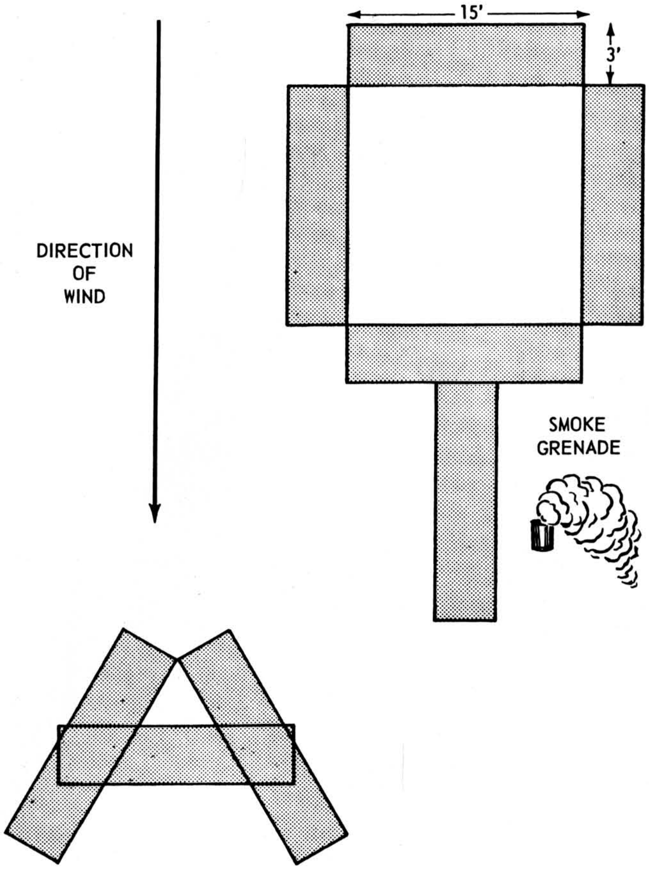


Figure 68. Helicopter site marker.

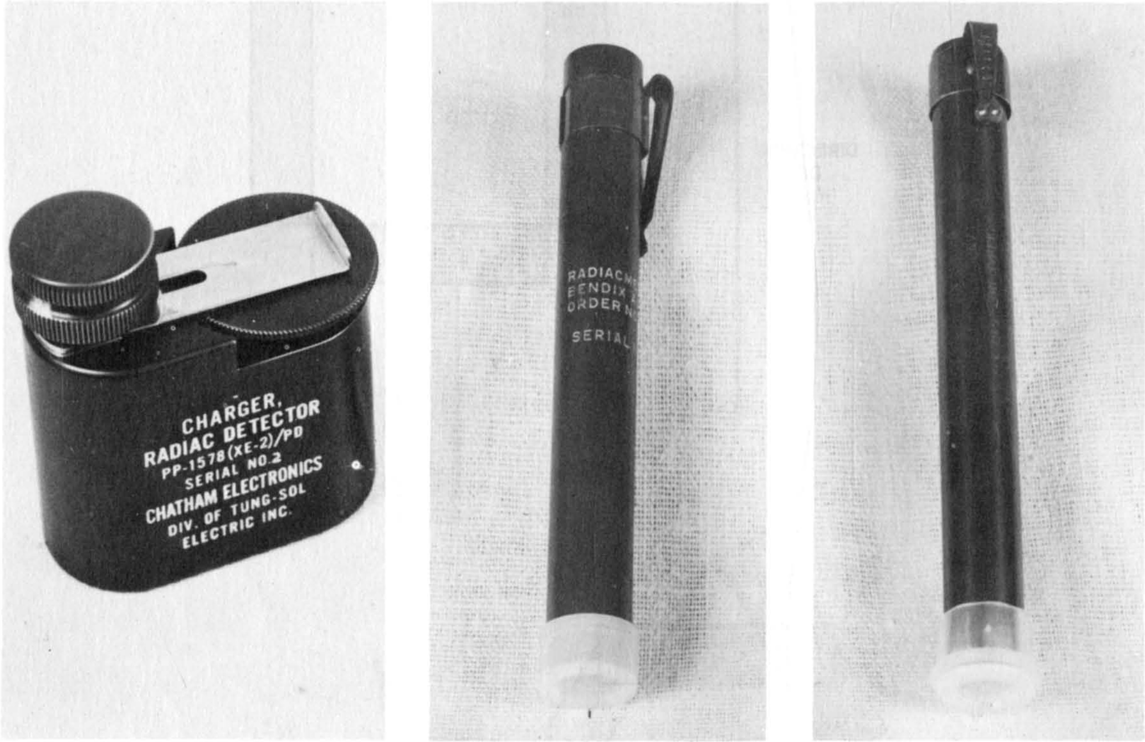
58. SOUND COMMUNICATION

Sound is a supplementary means of communication which is available to all armor units. Sound signals are kept simple to prevent misunderstanding and are transmitted by whistles, horns, gongs, weapons, and other noise-making devices. These signals require prearrangement, and their meanings are prescribed by the SSI, SOI, and unit SOP. These signals are used to give local alarm in the event of ground, air, mechanized, and gas attacks as well as in other emergencies.

59. MESSENGER

Messenger communication is an ancient, simple, and indispensable means of signal communication. This form of communication is extensively used at all echelons in armor units. Types of messengers commonly used include foot, motor, and Army aircraft. Messenger utilization includes scheduled runs between headquarters at all levels, special messengers for specific missions, and local messengers for use within headquarters and to subordinate organic units such as within a battalion command post and to companies. Messengers should be selected with care to ensure effective accomplishment of the mission.

Section XI. RADIAC EQUIPMENT



RADIAC DETECTOR CHARGER
PP-1578/PD

RADIAC METER
IM-147/UD

RADIAC METER
IM-93/UD

Figure 69. Radiac equipment.

60. RADIAC METER IM-93/UD AND RADIAC METER IM-147/UD

These meters are used to measure cumulative gamma radiation. They are issued to field units for use by individuals to determine the cumulative gamma radiation to which they have been exposed. The Radiac Meter IM-93/UD measures cumulative radiation from 0 to 600 roentgens. The IM-147/UD measures cumulative radiation from 0 to 50 roentgens. These dosimeters are read by holding the plastic end of the tube toward a light source and reading the cumulative total scale through the eye piece. The IM-147/UD will replace the chemical type dosimeters now in use, but will not replace the film badges.

61. RADIAC DETECTOR CHARGER PP-1578/PD

The PP-1578/PD is used to charge pocket dosimeters. It consists of a charger, adapter, and canvas carrying case. It replaces the PP-630 and PP-630A/PD.

62. RADIAC METER IM-108/PD

The IM-108/PD is an item of equipment used to measure intensity of radiation at any given moment; however, it does not measure cumulative radiation doses. It will be issued to field units and survey teams. Its purpose is to measure gamma radiation, and is capable of measuring both low and high radiation intensities. Figure 70 shows the IM-108/PD in the carrying case, complete; and also depicts a front view, rear view, and bottom view of the equipment. The IM-108/PD weighs 3.9 pounds, has a sensitivity of 0.5 to 500 mr/hr, and uses dry batteries. This equipment will replace the Radiac Set AN/PDR-39.

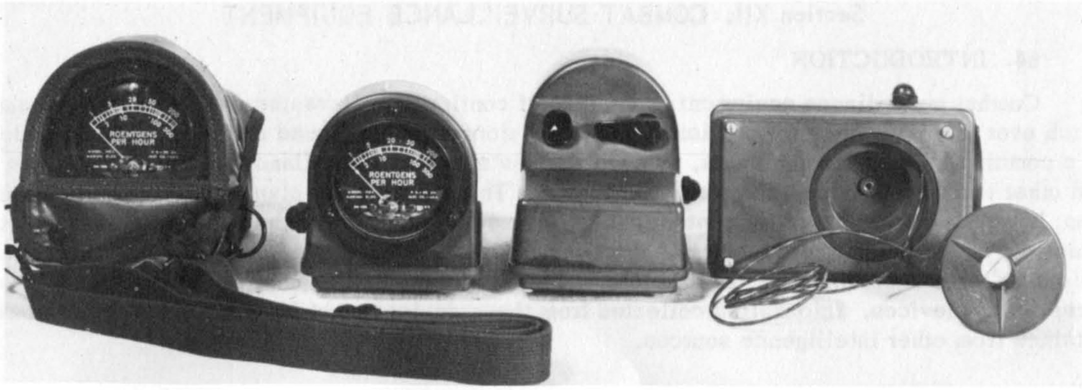


Figure 70. Radiac Meter IM-108/PD.

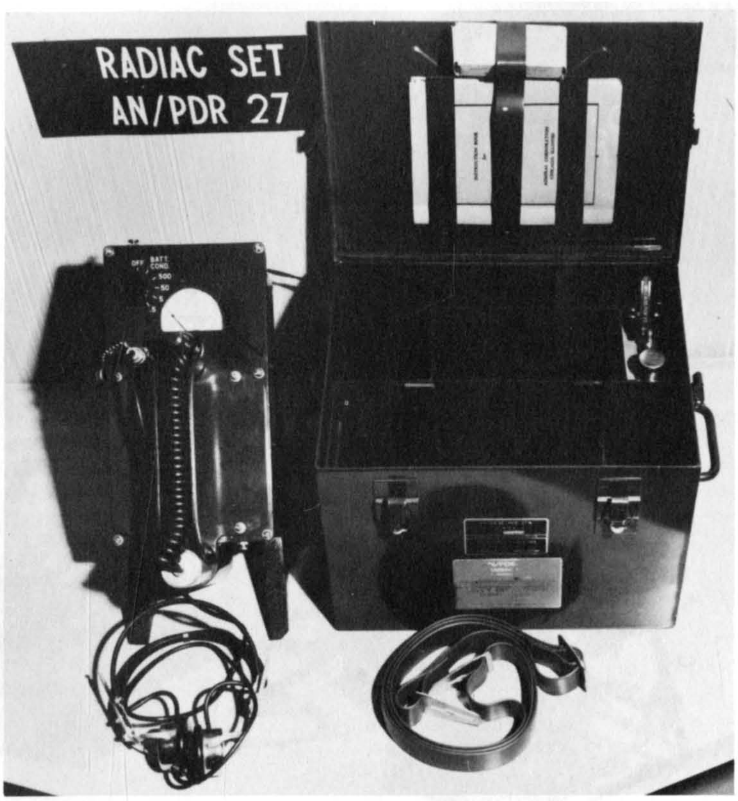


Figure 71. Radiac Set AN/PDR-27.

63. RADIAC SET AN/PDR-27

The AN/PDR-27 is a 0 to 500 mr/hr Geiger Mueller monitoring device, it is used for measuring low-intensity gamma and beta radiation. It is used primarily in the field to check contamination of personnel, food, equipment and other objects; it also can be used for making surveys of low-intensity radiation. The AN/PDR-27 contains four scales. They are numbered from 0 to .5 mr/hr for use with the probe, 0 to 5 mr/hr for use with the probe, 0 to 50 mr/hr for use with the instrument, and from 0 to 500 mr/hr for use with the instrument. The weight of the AN/PDR-27 is 8.81 pounds; the weight of the case is 8.62 pounds. This instrument supplements the Radiac Meter IM-108/PD.

Section XII. COMBAT SURVEILLANCE EQUIPMENT

64. INTRODUCTION

Combat surveillance equipment is capable of continuous all-weather, day or night systematic watch over the battle area for provision of timely information for ground operations. It is achieved by a combination of listening posts, observation posts, aerial surveillance, electronic devices, and other reconnaissance and surveillance means. The surveillance plan augments the collection plan; however, variations in its content and detail may be dictated by the weather, terrain, tactical situation, and/or higher headquarters. Short-range ground radar sets normally are organic to battalions or other subordinate units for employment. This ensures the most effective utilization of surveillance devices. Information collected from these devices must be correlated with information obtained from other intelligence sources.

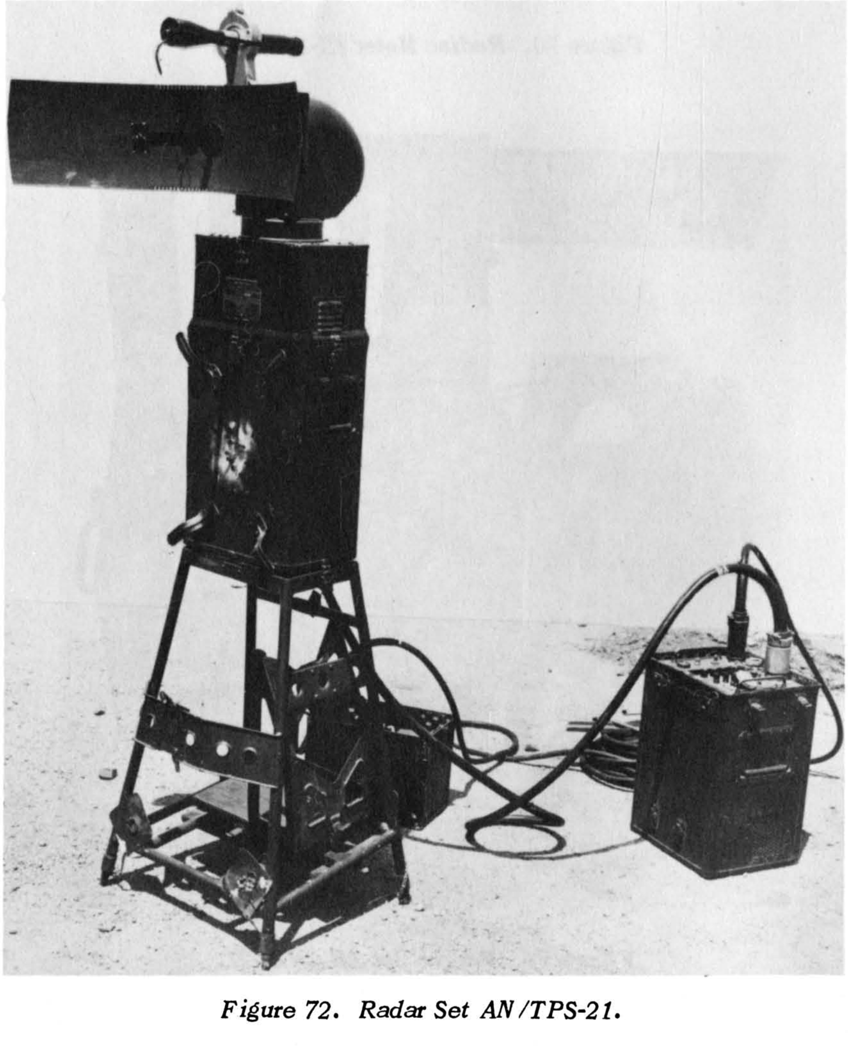


Figure 72. Radar Set AN/TPS-21.

65. RADAR SET AN/TPS-21

Radar Set AN/TPS-21 is a lightweight ground surveillance device. The set is divided into seven major components that may be arranged on packboards for man-pack transportation. Man-packing requires a crew of five men. Normal operation requires two men. A three man crew can prepare the set for operation in 15 minutes.

a. Technical Characteristics.

(1) Frequency (X-band)—9375 mc ± 30 mc.

(2) Peak power—5 to 7 kw.

(3) Average power—4 to 6 watts.

(4) Pulse rate—1600 pulses per second.

(5) Pulse width—0.5 microseconds.

(6) Beam width—10 degrees search; 3 degrees track.

(7) Indicators—Audio, meter readings, and azimuth readings.

(8) Power-supply voltage—115 AC, 400 cps, 28 DC.

(9) Power required (watts) for:

(*a*) Standby—210 AC, 60 DC.

(*b*) Operate—270 AC, 60 DC.

(*c*) Maximum—300 AC, 60 DC.

(10) Ambient temperature— –8 to +115 degrees F.

(11) Weight—431.5 pounds (uncrated).

b. Capabilities and Limitations.

(1) Affords only line-of-sight coverage.

(2) Ranges on ground targets from 100 to 20,000 yards.

(3) Is effective on low-flying aircraft.

66. RADAR SET AN/PPS-4

Radar Set AN/PPS-4 is a lightweight, short-range ground surveillance device. The set is designed for man-pack transportation on two packboards. Normal operation requires one man. A two-man crew can prepare it for normal operation in 10 minutes. (See fig. 73.)

a. Technical Characteristics.

(1) Peak power—1000 watts.

(2) Average power—1 watt.

(3) Repetition rate—3000 pulses per second.

(4) Pulse width—0.2 microsecond.

(5) Duty cycle—.001.

(6) System noise figure—13 decibels.

(7) RF frequency—X-band (tunable from 8900 to 9400 mcs).

(8) IF frequency—30 mcs.

(9) Beam width—6½ degrees.

(10) Range accuracy— ± 25 yards.

(11) Detection range—3000 yards on 1 square yard.

(12) Range capability—50 to 6000 yards.

(13) Power requirements—120 watts.

(14) Publications—CSTATC-R-M-2; Manual for Power Unit UGP-12.

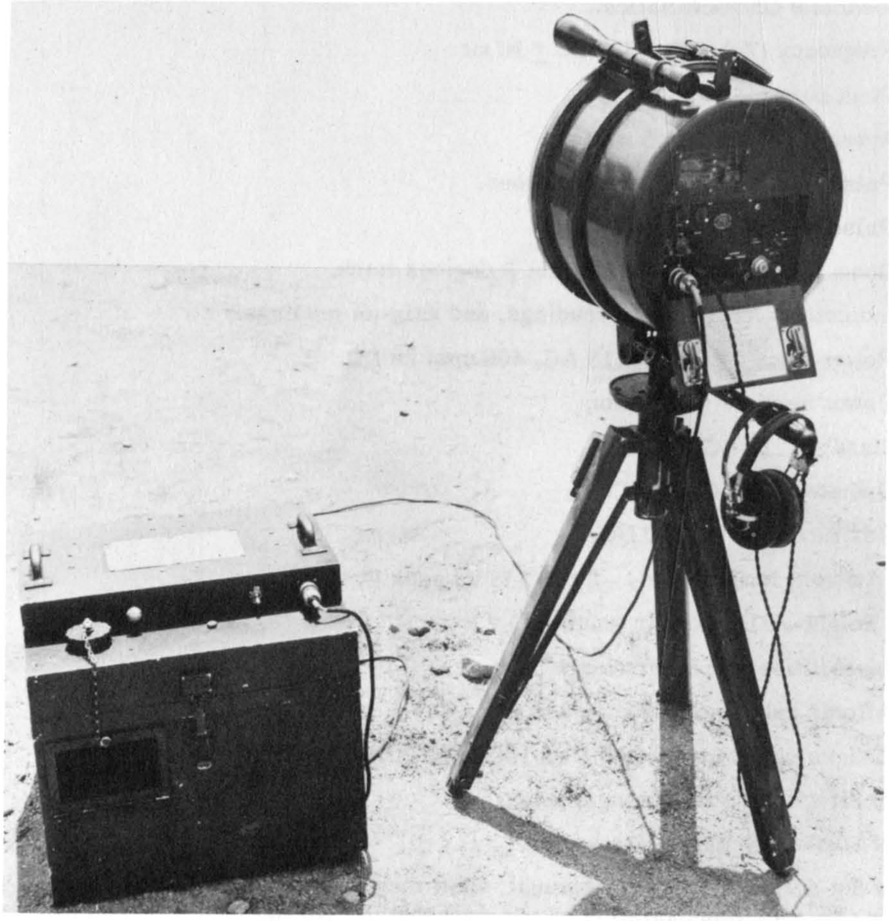


Figure 73. Radar Set AN/PPS-4.

b. Operating Procedure.

(1) Position the controls as follows:

Control	*Position*
POWER	OFF
TRANS	OFF
AGC-XTAL	XTAL
LIGHTS	OFF
GATE SELECTOR	NARROW
AUDIO VOLUME	MIDPOSITION

(2) Start the power unit by following instructions in the manual for the Power Unit UGP-12. Close the cover and allow 5 minutes warm-up time.

(3) At the radar set, turn the POWER switch to ON. Turn the LIGHT switch to ON if light is desired.

(4) Allow 1-minute warm-up time, then turn the TRANS switch to ON.

(5) Adjust the LO TUNE control for maximum reading on the meter. There should be at least an 0.8 reading.

(6) Turn the AGC-XTAL switch to AGC.

(7) Ensure that the Gate Selector switch is at NARROW.

(8) Direct the radar set at a large fixed target within a 3000-yard range by using peep sight.

(9) Rotate the SLANT RANGE control about the estimated range as read on the RANGE IN YDS X 100 dial, until a maximum deflection is obtained on the meter.

(10) Adjust the LO TUNE control for maximum meter reading. This adjustment should be made every 15 minutes to ensure maximum sensitivity of the set.

Note. A moving target will be indicated by a tone in the headset. This tone will vary in pitch with the speed of the moving target at the rate of about 30 cps for each mile per hour of target radial velocity. A fixed target will be indicated by the meter only.

Section XIII. MINE DETECTORS

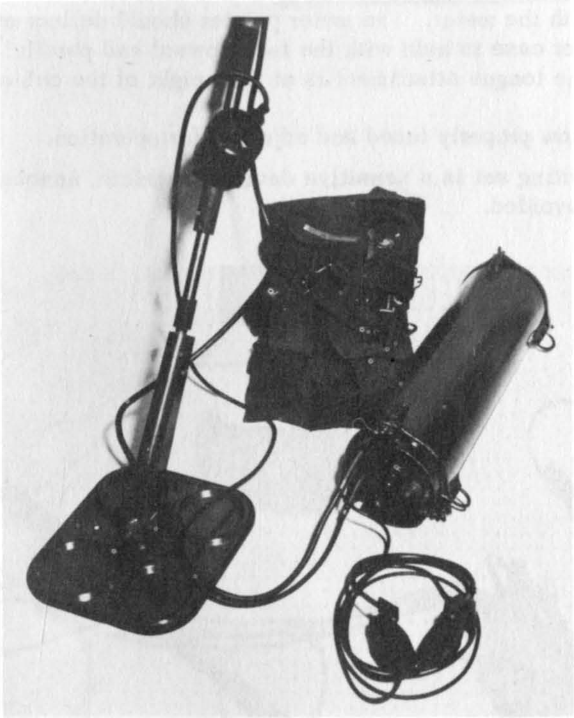


Figure 74. Detector Set, Mine, AN/PRS-3.

67. DETECTOR SET, MINE, AN/PRS-3

This mine detector is a portable instrument capable of detecting buried or hidden metallic objects such as antitank or antipersonnel mines. The presence of metallic objects is indicated visually by a meter and audibly by a headset.

a. Components.

(1) Search head.

(2) Handle assembly.

(3) Amplifier.

(4) Harness and knapsack.

(5) Headset and meter assembly.

Note. A transit case is provided for storage of the Detector Set.

b. Characteristics.

(1) Oscillator frequency—965 to 1035 cps.

(2) Tube complement—2 each IU5, 6 each IL4.

(3) Battery complement—1 each BA-15A, 2 each BA-51.

(4) A-battery voltage (BA-15A)—1.5 to 1.1 volts.

(5) B-battery voltage (BA-51)—135 to 110 volts.

(6) Battery life—4 to 5 hours.

(7) Pertinent publication—TM 5-9540.

c. Operating Procedure.

(1) Turn the power switch on the amplifier control panel to ON.

(2) Hold the search head 5 feet above the ground and away from metallic objects.

(3) Use the two control knobs on the amplifier control panel to adjust for minimum or null signal in the headset. Turn the knobs slowly one at a time in either direction for a minimum signal.

(4) When a minimum or null signal has been obtained in the headset, the sensitivity of the set should be checked with the meter. The meter pointer should deflect at least two scale divisions to the right when the meter case is held with the face upward and parallel to the search head. (Hold the meter so that the tongue attachment is at the height of the cable entrance to the short handle.)

Note. The set is now properly tuned and adjusted for operation.

Caution. The detecting set is a sensitive device; therefore, unnecessary rough handling must be avoided.

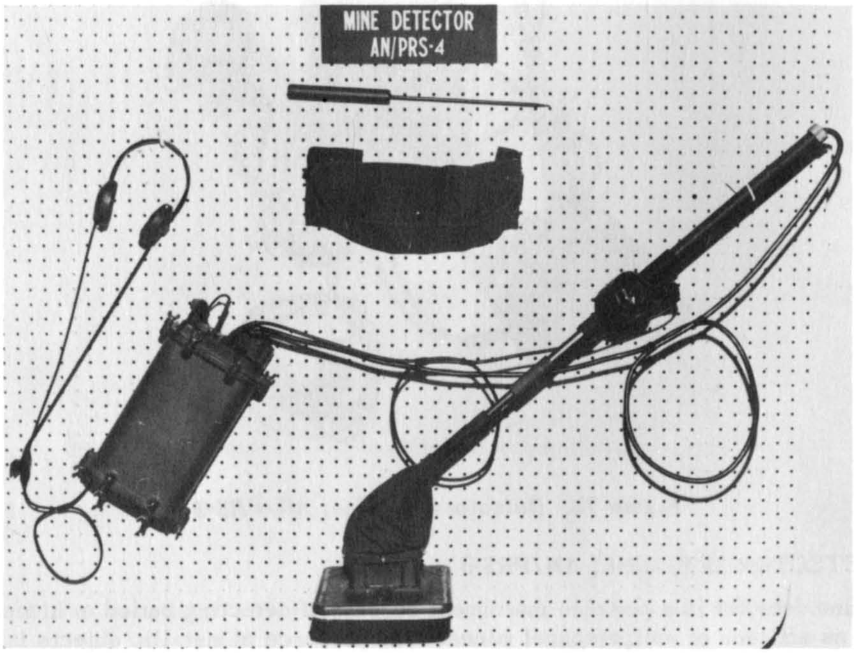


Figure 75. Detector Set, Mine, AN/PRS-4.

68. MINE DETECTOR SET AN/PRS-4

Mine Detector Set AN/PRS-4 (fig. 75) is a portable device capable of detecting nonmetallic objects; specifically, buried antitank and antipersonnel mines. The presence of a mine is indicated audibly through a headset assembly, and visibly on a meter assembly. There are three of these mine detectors in an armored division.

a. Components.

(1) Search head.
(2) Handle assembly.
(3) Amplifier.
(4) Harness and knapsack.
(5) Headset and meter assembly.
(6) Probe.

b. Characteristics.

(1) Oscillator frequency—390 mc (tolerance, +4 to −10 mc).
(2) Tube complement—2 each 1U5; 1 each 1U4; 1 each 5676; 1 each 6088.
(3) Battery complement—1 each 2-15-A; 2 each BA-51.
(4) A-battery voltage—1.5 to 1.1 volts.
(5) B-battery voltage—135 to 95 volts.
(6) Battery life (continuous operation)—8 to 10 hours.
(7) Pertinent publication—TM 5-9541.

c. Operating Procedure.

(1) Install the batteries.

(2) Place the search head on level ground and turn the SELECTOR switch to the SEARCH position.

(3) Wait 1 minute and check the meter to see that the reading does not exceed one division.

(4) If the meter reads more than one division, remove the plug on the side wall of the amplifier housing and adjust the screw-driver control marked C-31 until a null reading is obtained on the meter.

(5) Place a hand or foot over either side of the search head, and note the meter reading and headset level. This should cause an immediate full-scale meter reading and a loud signal in the headset.

(6) Turn the SELECTOR switch to the POINT position, and set the gain control full clockwise.

(7) Hold the search head in the air, away from persons or objects, and move the search head to produce a low meter reading and a low level in the headset.

(8) Repeat step (5) above.

(9) Turn the gain control clockwise, and check the meter and headset to see if the level of each indicator increases.

(10) When searching for mines, the SELECTOR switch should be in the SEARCH position. When an object is detected, place the SELECTOR switch in the POINT position. To outline a mine, make sure the SELECTOR switch is in the POINT position. Do *not* use SEARCH for outlining a mine.

Section XIV. RADIOTELEPHONE PROCEDURE

69. GENERAL

The purpose of this section is to prescribe the basic radiotelephone procedure that will be used for radiotelephone communication.

70. COMMUNICATION SECURITY

a. In the interest of security, transmission by radiotelephone should be as brief as possible. All radio users must be cautioned that transmissions by radiotelephone are subject to enemy interception and therefore have no security.

b. Adherence to prescribed procedure is mandatory. Unauthorized departures from or variations in prescribed procedures invariably create confusion, reduce reliability and speed, tend to to nullify security precautions, and therefore are prohibited. If the prescribed procedure does not cover a specific operating requirement, use initiative and common sense.

c. The following basic rules are essential to transmission security and will be strictly enforced on all military radiotelephone circuits.

(1) The following practices are specifically forbidden:

(*a*) Violation of radio silence.

(*b*) Unofficial conversation between operators.

(*c*) Transmitting in a directed net without permission.

(*d*) Excessive tuning and testing.

(*e*) Transmitting the operator's personal sign or name.

(*f*) Unauthorized use of plain language.

(*g*) Use of other than authorized prowords.

(*h*) Unauthorized use of plain language in place of applicable prowords or operating signals.

(*i*) Linkage or compromise of classified call signs and address groups by plain-language disclosures or association with unclassified call signs.

(*j*) Profane, indecent, or obscene language.

(2) The following practices are to be avoided:

(*a*) Use of excessive transmitting power.

(*b*) Transmitting at speeds beyond the capabilities of receiving operators.

71. OPERATING RULES

a. To save time, all messages should be planned before transmission.

b. Transmissions over radiotelephone must be complete, concise, and clear. Authorized radiotelephone procedure will be used.

c. The operator should hold or adjust the microphone no more than ½ inch from his lips. He should speak slowly and clearly, and never shout or blow into the microphone.

d. The operator should wait 3 seconds after depressing the PRESS-TO-TALK button before talking to allow the equipment to warm up.

72. PHONETIC ALPHABET

Note. See inside back cover.

a. Difficult words or groups within the text of plain-text messages may be spelled, using the phonetic alphabet and preceded by the proword I SPELL. If the operator can pronounce the word to be spelled, he will do so before and after the spelling to identify the word.

Example.

AMMUSONI–I SPELL–ALFA MIKE MIKE UNIFORM
SIERRA OSCAR NOVEMBER INDIA–AMMUSONI.

Example.

RENDEZVOUS POINT IS–I SPELL–UNIFORM
NOVEMBER INDIA MIKE ALFA KILO.

b. The phonetic alphabet will be used when transmitting isolated letters. For example, a map coorcinate BS190340 would be transmitted:

BRAVO SIERRA ONE NINER ZERO THREE FOUR ZERO.

c. Where the text is composed of pronounceable words, they will be spoken as such. Where the text is encrypted, the groups are to be transmitted by the phonetic equivalents of the individual letters and without the proword I SPELL.

Example.

The encrypted group LUXOW will be spoken LIMA UNIFORM XRAY OSCAR WHISKEY and counted as one group.

73. PRONUNCIATION OF NUMERALS

Note. See inside back cover.

74. PROWORDS AND THEIR MEANINGS

Prowords are pronounceable words or phrases which have been assigned meanings for the purpose of expediting message handling on circuits where radiotelephone procedure is employed.

Word or Phrase	*Meaning*
BREAK	I hereby indicate the separation of the text from other portions of the message.
CORRECTION	(1) An error has been made in this transmission. Transmission will continue with the last word correctly transmitted. (2) An error has been made in this transmission (or message indicated). The correct version is ____________. (3) That which follows is a corrected version in answer to your request for verification.
DISREGARD THIS TRANSMISSION	This transmission is in error. Disregard it. (This proword shall not be used to cancel any message that has been completely transmitted and for which receipt or acknowledgement has been received.)
GROUPS	This message contains the number of groups indicated by the numeral following.
I READ BACK	The following is my response to your instructions to read back.
I SAY AGAIN	I am repeating transmission or portion indicated.
I VERIFY	That which follows has been verified at your request and is repeated. (To be used only as a reply to VERIFY.)
MESSAGE FOLLOWS	A message which requires recording is about to follow. (Transmitted immediately after the call.)
FROM	The originator of this message is indicated by the address designation immediately following.
OUT	This is the end of my transmission to you and no answer is required or expected.
OVER	This is the end of my transmission to you and a response is necessary. Go ahead; transmit.
READ BACK	Repeat this entire transmission back to me exactly as received.
RELAY TO	Transmit this message to all addressees or to the address designations immediately following.
ROGER	I have received your last transmission satisfactorily.
SAY AGAIN	Repeat all of your last transmission. When followed by identification data, means: Repeat ____________ (portion indicated).
SILENCE	Cease transmissions immediately. (Silence will be maintained until lifted.)

Word or Phrase	*Meaning*
SILENCE LIFTED	(Silence can be lifted only by the station imposing it or by higher authority.)
THAT IS CORRECT	You are correct or what you have transmitted is correct. This must be used as a receipt for a READ BACK message.
THIS IS	This transmission is from the station whose designation immediately follows.
TIME	That which immediately follows is the time or date-time group of the message.
UNKNOWN STATION	The identity of the station with which I am attempting to establish communication is unknown.
VERIFY	Verify entire message (or portion indicated) with the originator and send correct version. (To be used only at the discretion of or by the addressee to which the questioned message was directed.)
WAIT	I must pause for a few seconds (not over 5 seconds).
WILCO	I have received your message, understand it, and will comply.
WORDS TWICE	Communication is difficult. Transmit(ting) each phrase (words or code group) twice. (This proword may be used as an order, as a request, or as information.)
WRONG	Your last transmission was incorrect. The correct version is ______ .

75. ESTABLISHING A NET

a. Nets are established as either free or directed nets. In a free net, any station may transmit at will to any other station in the net. In a directed net, a station must obtain the permission of the net control station (NCS) before making any transmission to another station in the net. Proper control by the NCS and adherence to operating rules by the stations within the net enable the nets to begin and maintain an exchange of traffic with minimum delay. The use of procedure as prescribed herein will be followed both when opening a net for the first time and when reopening a net. The following call signs are used to illustrate examples shown:

BLUEBIRD–Collective call sign for the net (net call sign).
BLUEBIRD 5–Net control station.
BLUEBIRD 6–Subordinate station.
BLUEBIRD 16–Subordinate station.
BLUEBIRD 26–Subordinate station.
BLUEBIRD 36–Subordinate station.
CAMERA 17–Subordinate station.

b. The establishment of a six-station net is shown in the following examples.

(1) *Example A.*

(*a*) At a designated time or when ready to establish the net, the NCS listens on the assigned frequency and, finding it clear, transmits:

BLUEBIRD–THIS IS BLUEBIRD 5–OVER.

(*b*) Each subordinate station then answers the initial transmission of the NCS above in alphabetical and numerical order as follows:

BLUEBIRD 5–THIS IS BLUEBIRD 6–OVER.
BLUEBIRD 5–THIS IS BLUEBIRD 16–OVER.
BLUEBIRD 5–THIS IS BLUEBIRD 26–OVER.
BLUEBIRD 5–THIS IS BLUEBIRD 36–OVER.
BLUEBIRD 5–THIS IS CAMERA 17–OVER.

(c) As he has heard from all subordinate stations, the NCS now calls the net collectively and indicates that the net is now established.

BLUEBIRD–THIS IS BLUEBIRD 5–OUT.

(2) *Example B.*

(a) In this example, one subordinate station, BLUEBIRD 26, is unable to answer the collective call of the NCS. The delinquent station, BLUEBIRD 26, answers as the last subordinate station.

BLUEBIRD–THIS IS BLUEBIRD 5–OVER.
BLUEBIRD 5–THIS IS BLUEBIRD 6–OVER.
BLUEBIRD 5–THIS IS BLUEBIRD 16–OVER.

(b) BLUEBIRD 36, hearing no answer from BLUEBIRD 26, waits approximately 5 seconds, then answers in turn. The delinquent station answers last, as a subordinate station.

BLUEBIRD 5–THIS IS BLUEBIRD 36–OVER.
BLUEBIRD 5–THIS IS CAMERA 17–OVER.
BLUEBIRD 5–THIS IS BLUEBIRD 26–OVER.
BLUEBIRD–THIS IS BLUEBIRD 5–OUT.

(c) If the delinquent station in (b) above, still has not answered, the NCS would attempt to contact the station as shown below.

BLUEBIRD 26–THIS IS BLUEBIRD 5–OVER.

As he has received no answer from BLUEBIRD 26, the NCS would transmit:

BLUEBIRD–EXEMPT BLUEBIRD 26–THIS IS BLUEBIRD 5–OUT.

(d) The delinquent station, BLUEBIRD 26, when able to enter the net will call the NCS and transmit:

BLUEBIRD 5–THIS IS BLUEBIRD 26 REPORTING INTO THE NET–OVER.

The NCS then would receipt to the station BLUEBIRD 26:

BLUEBIRD 26–THIS IS BLUEBIRD 5–ROGER–OUT.

76. PRELIMINARY CALLS

When communication is difficult, or when the calling station wishes to ascertain whether the station called is ready to receive a message, a preliminary call will be sent before transmitting a message. The following is an example of how a preliminary call is conducted.

a. BLUEBIRD 6 wishes to transmit a message to BLUEBIRD 16 and desires to know if BLUEBIRD 16 is ready to accept it. BLUEBIRD 6 transmits:

BLUEBIRD 16–THIS IS BLUEBIRD 6–OVER.

b. Station BLUEBIRD 16, ready to accept the message, transmits:

BLUEBIRD 6–THIS IS BLUEBIRD 16–OVER.

Note. MESSAGE FOR YOU and SEND YOURMESSAGE are optional words or phrases which may be transmitted as part of a preliminary call.

77. TRANSMITTING A MESSAGE

a. When communication reception is satisfactory, message parts (heading, text, and ending) need to be transmitted only once and preliminary calls are optional.

Example. BLUEBIRD 26–THIS IS BLUEBIRD 6–PROCEED TO OBJECTIVE AREA BLUE–OVER.

BLUEBIRD 26, having received the above message satisfactorily, transmits:

BLUEBIRD 6–THIS IS BLUEBIRD 26–ROGER–OUT.

b. When communication is difficult, call signs will be made twice. Phrases, words, or groups will be transmitted twice, this being indicated by the proword WORDS TWICE. Under such conditions, preliminary calls normally are employed.

Examples. BLUEBIRD 6–BLUEBIRD 6–THIS IS BLUEBIRD 16–BLUEBIRD 16–OVER–OVER.

BLUEBIRD 16–BLUEBIRD 16–THIS IS BLUEBIRD 6–BLUEBIRD 6–OVER–OVER.

BLUEBIRD 6–BLUEBIRD 6–THIS IS BLUEBIRD 16–BLUEBIRD 16–WORDS TWICE–WORDS TWICE–PROCEED TO OBJECTIVE AREA BLUE–PROCEED TO OBJECTIVE AREA BLUE–OVER–OVER.

BLUEBIRD 16–BLUEBIRD 16–THIS IS BLUEBIRD 6–BLUEBIRD 6–ROGER–ROGER–OUT–OUT.

78. CORRECTION OF ERRORS DURING TRANSMISSION

a. When an error is made by a transmitting operator during a transmission, the proword CORRECTION will be transmitted followed by the last word, group, proword or phrase correctly transmitted. Transmission then continues.

Example. BLUEBIRD 26–THIS IS BLUEBIRD 6–AREA BRAVO MINED AND MARKED–RESORT–CORRECTION–MARKED–REPORT LOCATION–OVER.

b. When an error in the transmission is discovered before the transmission is concluded, the word, group, proword, or phrase in error must be properly identified and the correct version given.

Notes. 1. The following prowords are used in conjunction with the proword CORRECTION to identify the portion to be corrected: WORD AFTER, WORD BEFORE, ALL AFTER, and ALL BEFORE.

Example. BLUEBIRD 26–THIS IS BLUEBIRD 6–TRUCK CONVOY WILL ARRIVE 1600–CLASS FIVE SUPPLIES ABOARD–CORRECTION–WORD AFTER ARRIVE–1800 OVER.

2. During the transmission of a message and prior to the transmission of the ending proword OVER or OUT, a transmission in error may be cancelled by the use of the prowords DISREGARD THIS TRANSMISSION–OUT. A message which has been completely transmitted may be cancelled only by another message.

79. REPETITIONS

A receiving operator who has missed, or is not certain of, a part or parts of a message may request a repetition by one of the following methods. The transmission below will be used to illustrate various methods of requesting and answering repetitions.

Notes. 1. The prowords SAY AGAIN, used alone or in conjunction with ALL AFTER, ALL BEFORE, WORD AFTER, WORD BEFORE ______ TO ______ are used for the purpose of identifying the portions requested.

2. The prowords I SAY AGAIN used alone or in conjunction with the prowords in note 1, above, are used to identify the portion being repeated.

BLUEBIRD 26–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–ROUTINE–TIME 181000S–ROAD TO TANZAGAR CLEAR–PROCEED ON ASSIGNED MISSION–OVER.

a. If the operator at station BLUEBIRD 26 were to miss the entire message, he would transmit:

BLUEBIRD 6–THIS IS BLUEBIRD 26–SAY AGAIN –OVER.

In response to the request of BLUEBIRD 26, BLUEBIRD 6 would transmit:

BLUEBIRD 26–THIS IS BLUEBIRD 6–I SAY AGAIN–BLUEBIRD 26–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–ROUTINE–TIME 181000S–ROAD TO TANZAGAR CLEAR–PROCEED ON ASSIGNED MISSION–OVER.

b. If the operator at station BLUEBIRD 26 misses only those words of the message following ON, he would request the missing portion by transmitting:

BLUEBIRD 6–THIS IS BLUEBIRD 26–SAY AGAIN ALL AFTER ON–OVER.

In response to the request of BLUEBIRD 26, BLUEBIRD 6 would transmit:

BLUEBIRD 26–THIS IS BLUEBIRD 6–I SAY AGAIN ALL AFTER ON–ASSIGNED MISSION–OVER.

c. If the operator at station BLUEBIRD 26 were doubtful of all of the message before the word ROAD, he would request the missing portion by transmitting:

BLUEBIRD 6–THIS IS BLUEBIRD 26–SAY AGAIN ALL BEFORE ROAD–OVER.

In response to this request, BLUEBIRD 6 would transmit:

BLUEBIRD 26–THIS IS BLUEBIRD 6–I SAY AGAIN ALL BEFORE ROAD–BLUEBIRD 26–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–ROUTINE–TIME 181000S–OVER.

d. If the operator at station BLUEBIRD 26 were to miss the seventh word of the message, he would request a repetition of the missing portion by transmitting:

BLUEBIRD 6–THIS IS BLUEBIRD 26–SAY AGAIN WORD AFTER ON–OVER.

In response to this request of BLUEBIRD 26, BLUEBIRD 6 would transmit:

BLUEBIRD 26–THIS IS BLUEBIRD 6–I SAY AGAIN WORD AFTER ON–ASSIGNED–OVER.

Note. The same procedure would also apply with the prowords WORD BEFORE in the above example.

e. If the operator of station BLUEBIRD 26 were to miss that portion of the message between the word TANZAGAR and the word ASSIGNED, he would request a repetition by transmitting:

BLUEBIRD 6–THIS IS BLUEBIRD 26–SAY AGAIN TANZAGAR TO ASSIGNED–OVER.

In response to the request of BLUEBIRD 26, BLUEBIRD 6 would transmit:

BLUEBIRD 26–THIS IS BLUEBIRD 6–I SAY AGAIN TANZAGAR TO ASSIGNED–TANZAGAR CLEAR–PROCEED ON ASSIGNED–OVER.

Note. When requesting repetition of portions of messages consisting of code groups or clear text, the code groups or words concerned will always be identified by repeating the adjacent code groups or words, or by use of a group count.

80. APPLICATION TO "READ BACK" MESSAGE

If it is desired that a message or a portion thereof be read back, the prowords READ BACK and identifying data will be transmitted immediately following the call. Uses of READ BACK are illustrated in the following.

a. BLUEBIRD 6 has a message for BLUEBIRD 36. BLUEBIRD 6 directs BLUEBIRD 36 to repeat the entire transmission back exactly as it was received. BLUEBIRD 6 transmits:

BLUEBIRD 36–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–READ BACK–ROUTINE–TIME 150910S–GROUPS 5 AF TR FJ OK PN–OVER.

(1) BLUEBIRD 36 receives the message above without difficulty and transmits:

BLUEBIRD 6–THIS IS BLUEBIRD 36–I READ BACK–BLUEBIRD 36–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–READ BACK–ROUTINE–TIME 150910S–GROUPS 5 AF TR FJ OK PN–OVER.

(2) BLUEBIRD 36 reads back the message of BLUEBIRD 6 correctly. BLUEBIRD 6 transmits:

BLUEBIRD 36–THIS IS BLUEBIRD 6–THAT IS CORRECT–OUT.

Note. The proword THAT IS CORRECT is used by the originator as a method of receipt. Its use indicates to the addressee that the message or portion of a message read back by the addressee was exactly as transmitted by the originator.

b. Assume that BLUEBIRD 36, in response to the instructions of BLUEBIRD 6 to read back the message in *a,* above repeats the message incorrectly, making a mistake in the third code group. In this situation, BLUEBIRD 6 notices that the third group was repeated incorrectly and transmits:

THIS IS BLUEBIRD 6–WRONG–WORD AFTER TR–FJ–OVER.

(1) In response to the above transmission of BLUEBIRD 6, BLUEBIRD 36 transmits:

THIS IS BLUEBIRD 36–WORD AFTER TR–FJ–OVER.

(2) BLUEBIRD 6, receives the transmission from BLUEBIRD 36 correctly and transmits:

THIS IS BLUEBIRD 6–THAT IS CORRECT–OUT.

c. Assume that BLUEBIRD 6 has a message for BLUEBIRD 36. BLUEBIRD 6 directs BLUEBIRD 36 to read back the text of the message exactly as it is received. BLUEBIRD 6 transmits:

BLUEBIRD 36–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–READ BACK TEXT–ROUTINE–TIME 150910S–GROUPS 5 AF TR FJ OK PN–OVER.

(1) BLUEBIRD 36 receives the message above without difficulty and transmits:

BLUEBIRD 6–THIS IS BLUEBIRD 36–I READ BACK TEXT–AF TR FJ OK PN–OVER.

(2) As BLUEBIRD 36 has read back the text correctly, BLUEBIRD 6 transmits:

THIS IS BLUEBIRD 6–THAT IS CORRECT–OUT.

81. VERIFICATIONS

When verification of a message or a portion thereof has been requested by the addressee, the originating station will verify with the originator, and send the correct version.

a. Assume that the message time 150910S transmitted by BLUEBIRD 6 to BLUEBIRD 36 is not understood. BLUEBIRD 36 transmits:

BLUEBIRD 6–THIS IS BLUEBIRD 36–VERIFY MESSAGE–TIME 150910S–ALL AFTER GROUPS 5–OVER.

b. Assume that the text of the message has been checked and verified by the originator and the encoding is correct. BLUEBIRD 6 transmits:

BLUEBIRD 36–THIS IS BLUEBIRD 6–I VERIFY MESSAGE–TIME 150910S–ALL AFTER GROUPS 5–AF TR FJ OK PN–OVER.

c. Assume that the text has been verified by the originator and the encoding is incorrect: Code Group FJ should have been FG. BLUEBIRD 6 would transmit:

BLUEBIRD 36–THIS IS BLUEBIRD 6–CORRECTION–MESSAGE–TIME 150910S–ALL AFTER GROUPS 5–AF TR FG OK PN–OVER.

82. RELAY

The prowords RELAY TO, followed by a call sign, indicates that the station called is to relay the message to the station indicated. When more than one station is called, the call sign of the station designated to perform the relay will precede the prowords RELAY TO.

a. Assume that BLUEBIRD 6 has a message for BLUEBIRD 26 which has to be relayed through BLUEBIRD 16. After making a preliminary call to BLUEBIRD 16, BLUEBIRD 6 would transmit:

BLUEBIRD 16–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–RELAY TO BLUEBIRD 26–PRIORITY–TIME 150800S–FROM BLUEBIRD 6–RETURN TO ASSEMBLY AREA BLUE–OVER.

b. Assume that BLUEBIRD 16 receives the message with its relay instructions without difficulty. BLUEBIRD 16 would transmit:

BLUEBIRD 6–THIS IS BLUEBIRD 16–ROGER–OUT.

BLUEBIRD 16 would then call BLUEBIRD 26. After communication has been established, BLUEBIRD 16 would transmit:

BLUEBIRD 26–THIS IS BLUEBIRD 16–MESSAGE FOLLOWS–PRIORITY–TIME 150800S–FROM BLUEBIRD 6–RETURN TO ASSEMBLY AREA BLUE–OVER.

Note. Relay procedure in multiple address messages may be further extended through the use of the proword TO (action) and INFO (information) followed by appropriate addresses when required.

83. DO NOT ANSWER

When it is imperative that called stations do not answer a transmission, the prowords DO NOT ANSWER are used.

Assume that BLUEBIRD 6 has a message for BLUEBIRD 16 and, for security reasons, does not want BLUEBIRD 16 to answer his call or receipt for the message. BLUEBIRD 6 would transmit:

> BLUEBIRD 16–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–DO NOT ANSWER–ROUTINE–TIME 150735S–GROUPS 3–RXTCP–TWUVH–PCVQR–I SAY AGAIN–BLUEBIRD 16–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–DO NOT ANSWER–ROUTINE–TIME 150735S–GROUPS 3–RXTCP–TWUVH–PCVQR–OUT.

Note. In transmission of a do-not-answer message, the entire transmission is sent twice, connected by the operating phrase I SAY AGAIN.

84. ACKNOWLEDGEMENTS

The originator of a message frequently may desire acknowledgement of the understanding of the message and the ability of the addressee to execute the indicated action. An acknowledgement should not be confused with a reply or receipt. A prompt reply referring to the message may serve in lieu of an acknowledgement. It is the prerogative of the originator to request an acknowledgement of a message from the addressee of that message. If an acknowledgement is desired for the message, the request for acknowledgement is included in the text of that message. Acknowledgements are originated only by the addressee to whom the request for acknowledgement was made. On many radiotelephone circuits employing radio-telephone procedure, the addressee is either operating the circuit or is in close proximity to the operator. In these instances, when no delay in answering will result, the response to the transmission may represent the acknowledgement; the proword WILCO is authorized for this method of acknowledgement. However, when this situation does not exist, the operator shall receipt in the usual manner and the acknowledgement will be sent later.

a. Assume that BLUEBIRD 6 has an ACKNOWLEDGE message for BLUEBIRD 26. In this situation, after making a preliminary call, BLUEBIRD 6 transmits:

Note. The originator sends the word ACKNOWLEDGE as the last word of the text as shown below.

> BLUEBIRD 26–THIS IS BLUEBIRD 6–MESSAGE FOLLOWS–TIME 150955S–MOVE TO ALTERNATE POSITION–ACKNOWLEDGE–OVER.

b. The addressee represented by the call sign BLUEBIRD 26 is operating his own radio set. BLUEBIRD 26 acknowledges by transmitting:

> THIS IS BLUEBIRD 26–WILCO–OUT.

c. Assume that the addressee BLUEBIRD 26 is not in close proximity to the radio operator, or desires to consider the message before acknowledging. In this situation, BLUEBIRD 26 transmits:

> THIS IS BLUEBIRD 26–ROGER–OUT.

d. When the addressee is ready to acknowledge, he transmits, or informs the operator who transmits:

> BLUEBIRD 6–THIS IS BLUEBIRD 26–YOUR MESSAGE–TIME 150955S–ACKNOWLEDGED–OVER.

e. BLUEBIRD 6 has received the acknowledgement of his message time 150955S, so he now transmits:

> THIS IS BLUEBIRD 6–ROGER–OUT.

85. CLOSING THE NET

When the NCS has been instructed to close a voice radio net, the following procedure applies:

Notes.
1. The NCS uses the prowords CLOSE STATIONS in giving the order to close the net.
2. Subordinate stations answer in alphabetical and numerical order as shown.

BLUEBIRD–THIS IS BLUEBIRD 5–CLOSE STATIONS–OVER.

THIS IS BLUEBIRD 6–ROGER–OUT.
THIS IS BLUEBIRD 16–ROGER–OUT.
THIS IS BLUEBIRD 26–ROGER–OUT.
THIS IS BLUEBIRD 36–ROGER–OUT.
THIS IS CAMERA 17–ROGER–OUT.

Note. The proword WILCO may be used in lieu of the proword ROGER (used above) as a means of receipt.

Section XV. SIGNAL SUPPLY

86. GENERAL

Supply for signal equipment is complex, and a thorough understanding of the supply publications is required before one can properly follow the normal procedures prescribed for signal supply. The following is a list of the more common signal supply publications and their intended uses.

Manual	*Description*
a. DA Pamp 310-21.	Provides a complete list of up-to-date Signal Corps manuals.
b. SIG 1.	Introduces all Signal Corps supply manuals and explains what types of information are included in each of the manuals.
c. SIG 3.	Provides proper nomenclature, stock number, unit of measure, and pictures of most signal items which appear in the table of allowance (TA) and/or table of organization and equipment (TOE).
d. SIG 5-2, Part 2.	
(1) Volume 3 and 4.	Is used to locate federal stock numbers when the Signal Corps stock numbers are known.
(2) Volume 1 and 2.	Is used to locate Signal Corp stock numbers when the federal stock numbers are known.
e. SM 11-2-1, SM 11-2-2, and SM 11-2-3.	A pricing guide used for determining the cost of Signal Corps items when compiling data for statements of charges, reports of survey, reports of collection, etc.
f. SIG 7 and 8.	Provides the necessary information for determining authorized spare parts or maintenance parts for signal equipment. This manual can be used for a basis when requisitioning Signal Corps items.
g. SIG 6.	Provides a complete list of component parts of each tool set, test equipment set, and maintenance set.
h. SB 11-131.	Used for requisitioning a radio that is to be installed in a vehicle, and to obtain the correct stock number of the installation unit or installation kit that will be needed to complete the job.
i. SB 11-6.	Provides a basis for requisitioning dry batteries, gives consumption data for a 30-day period, and specifies the quantity to be issued for each piece of Signal Corps equipment.

Section XVI. DIVISION AREA COMMUNICATION SYSTEM

87. INTRODUCTION

Under the division area communication system concept, signal centers and switching points are established and operated by the division signal battalion throughout the division area to provide signal support for the dispersed elements of the division. These signal centers and switching points are interconnected by multichannel radio relay and, when the situation permits, by field cable in such configuration as to provide alternate routes between any two points in the system. This area coverage capability of the system, with dispersed signal centers and alternate routes of adequate capacity, enhances the operational flexibility of the division, facilitates dispersion of elements, provides greater signal services at more extended distances, and decreases the vulnerability of the system to damage. The division area communication system is comprised mainly of common user circuits; however, to meet special requirements, a number of sole user circuits may be allocated to provide point-to-point communication.

88. DIVISION AREA COMMUNICATION SYSTEM.

a. The various signal centers of the division area communication system provide:

(1) Points of entry into the system for supported headquarters, units, and installations to facilitate their use of the radio-relay circuits and wire trunks of the system.

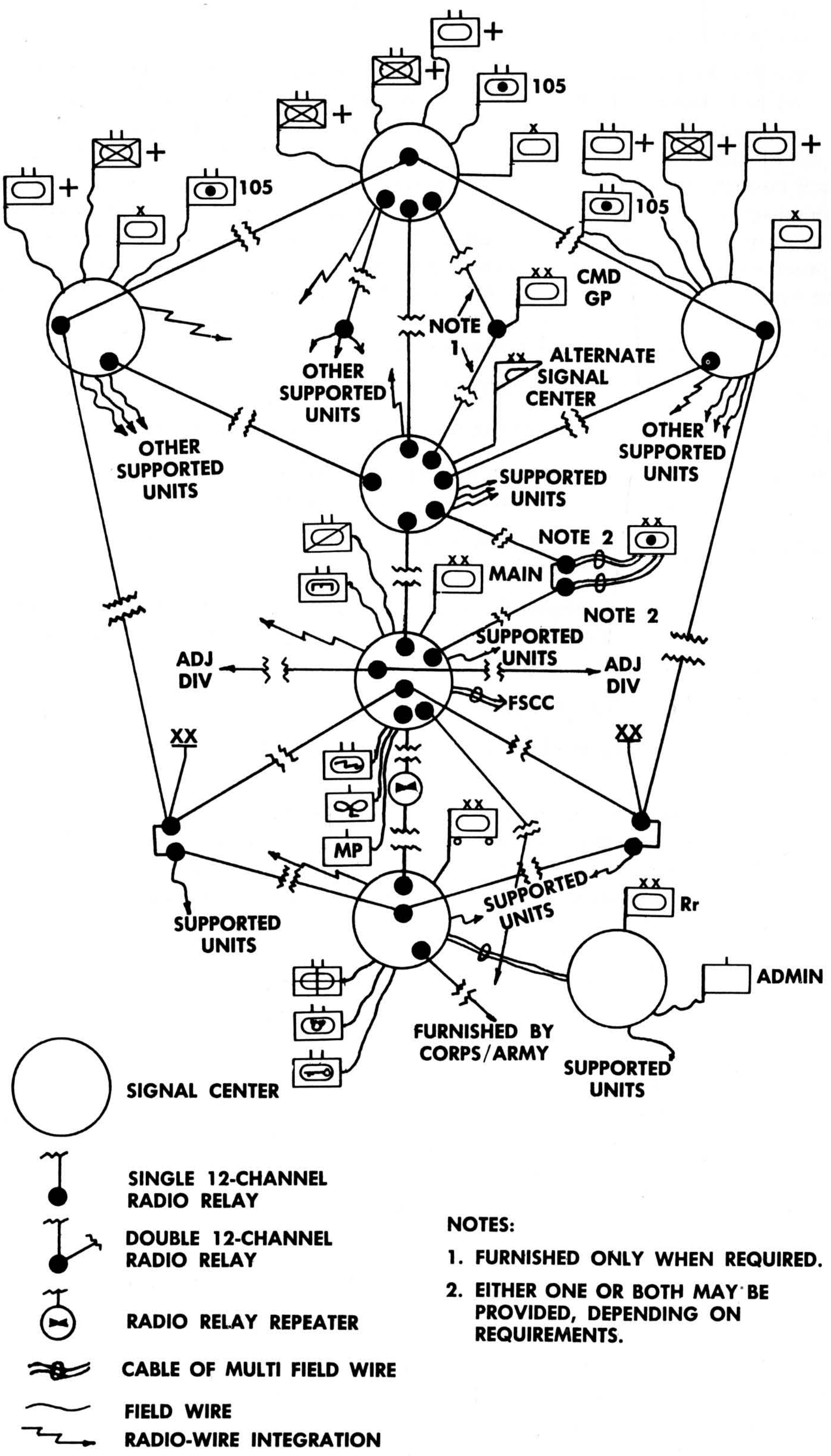
(2) Terminal, testing, patching, and switching facilities for the radio-relay circuits, field wire trunks, and local lines in the system.

(3) Local communication center facilities, including message center, messenger, cryptographic, teletypewriter, and telephone switchboard service for designated headquarters and units as required to supplement organic capabilities.

(4) Radio-wire integration stations at designated headquarters.

(5) Installation of designated field wire trunks and long-line locals as required throughout the division area.

b. The signal centers in the division area communication system normally are located with or near major headquarters of the division, and are extended to other users by field wire and/or radio-wire integration links. The division area communication system supplements FM, AM, and RTT radio nets and wire systems installed and operated by elements of the division.



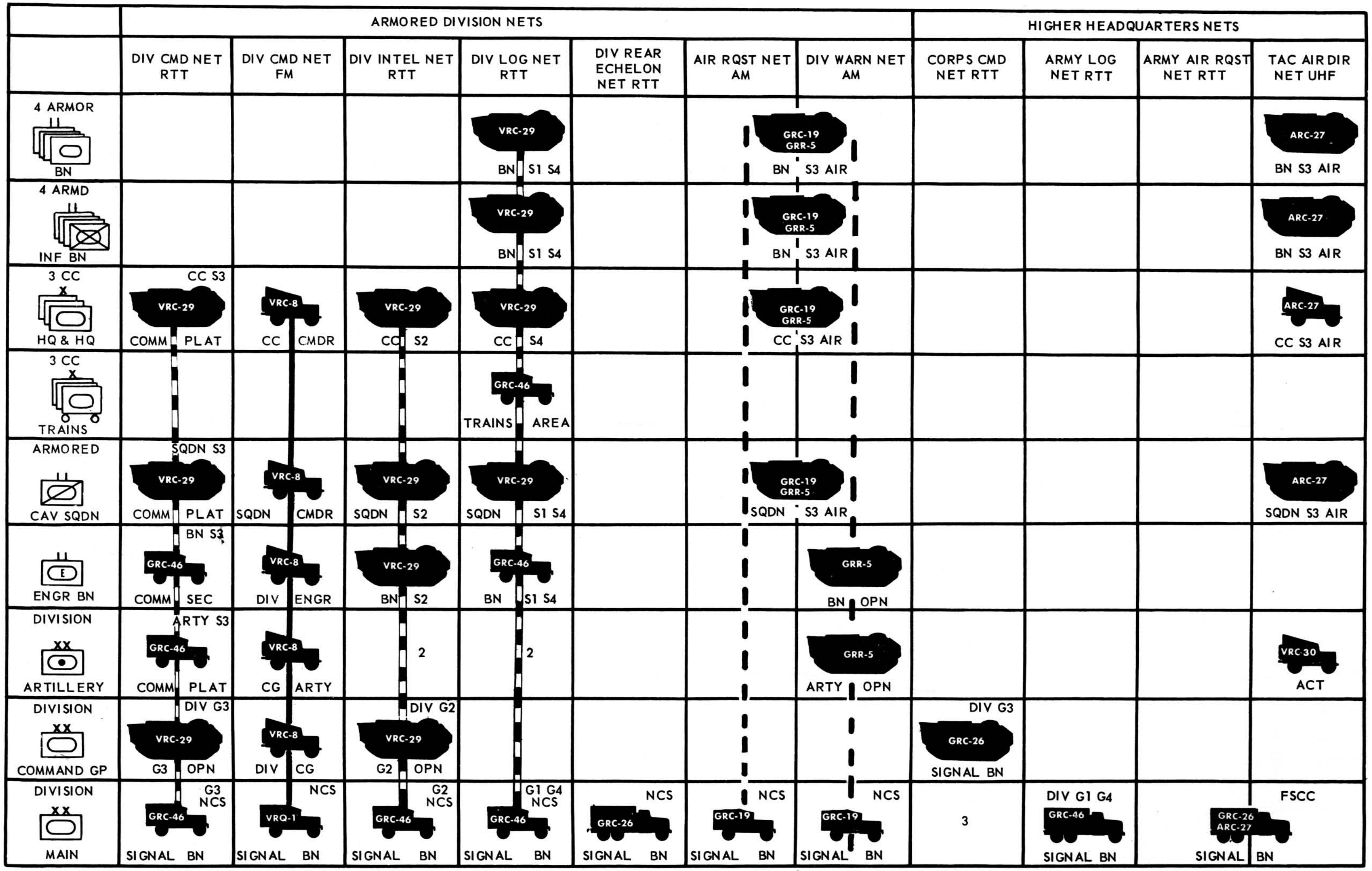
NOTES:

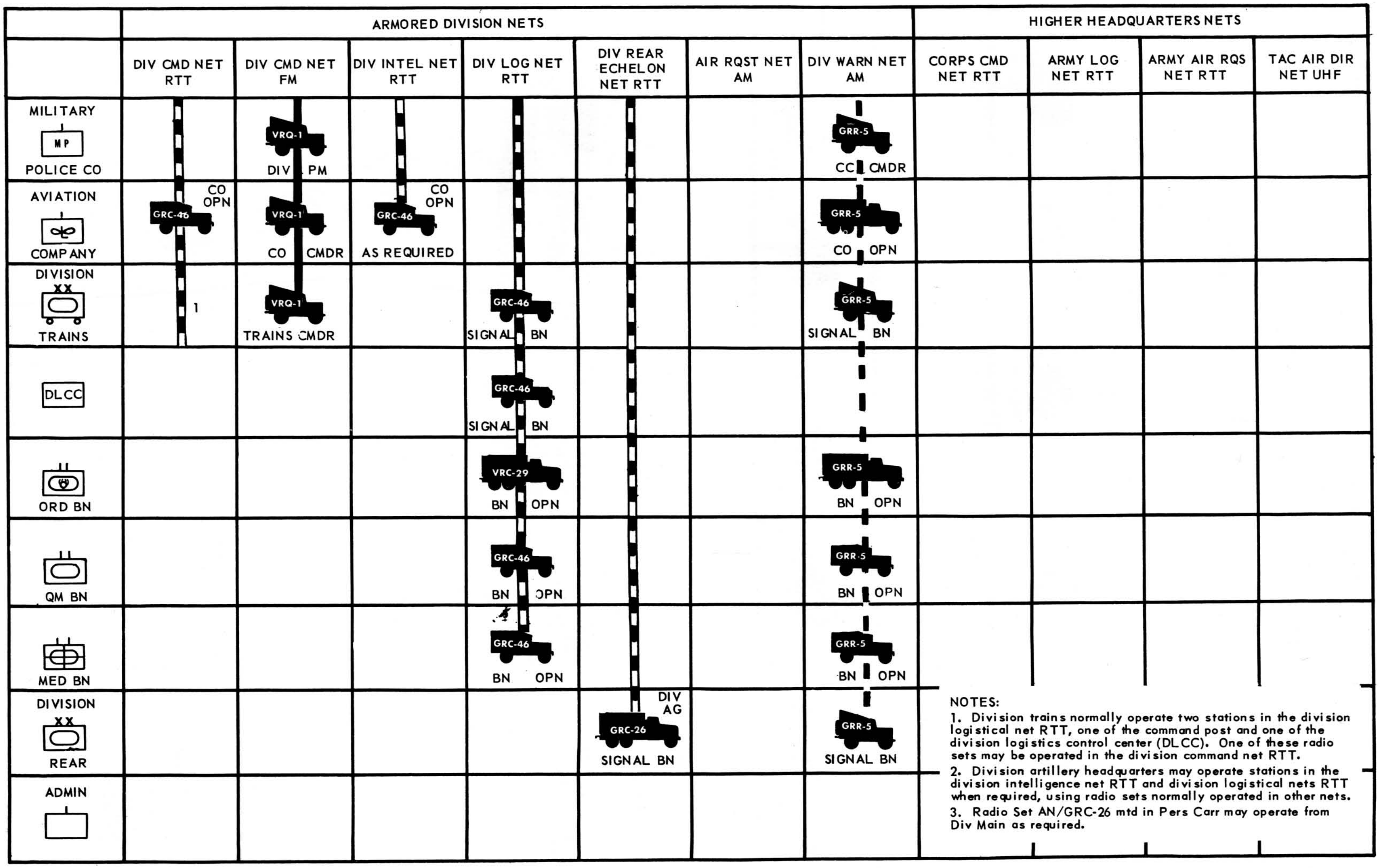
1. FURNISHED ONLY WHEN REQUIRED.
2. EITHER ONE OR BOTH MAY BE PROVIDED, DEPENDING ON REQUIREMENTS.

Figure 76. Typical armored division area communication system.

89. RADIO AND WIRE NETS

The following diagrams are typical radio and wire nets utilizing authorized TOE equipments. These radio and wire nets are depicted as taught at the US Army Armor School. However, the configuration of these nets may change in accordance with the requirements of the unit involved, or the desires of the unit commander.

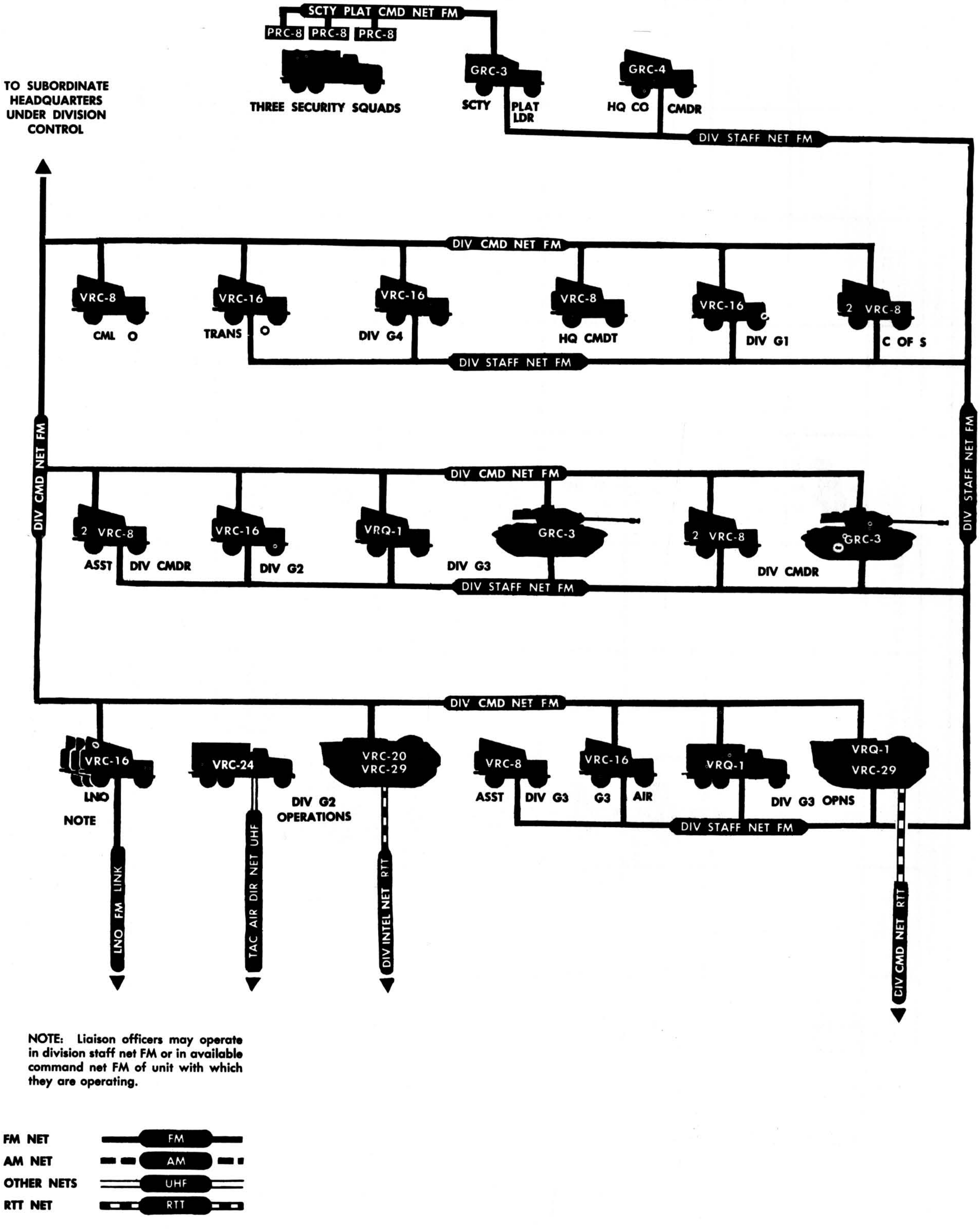




NOTES:

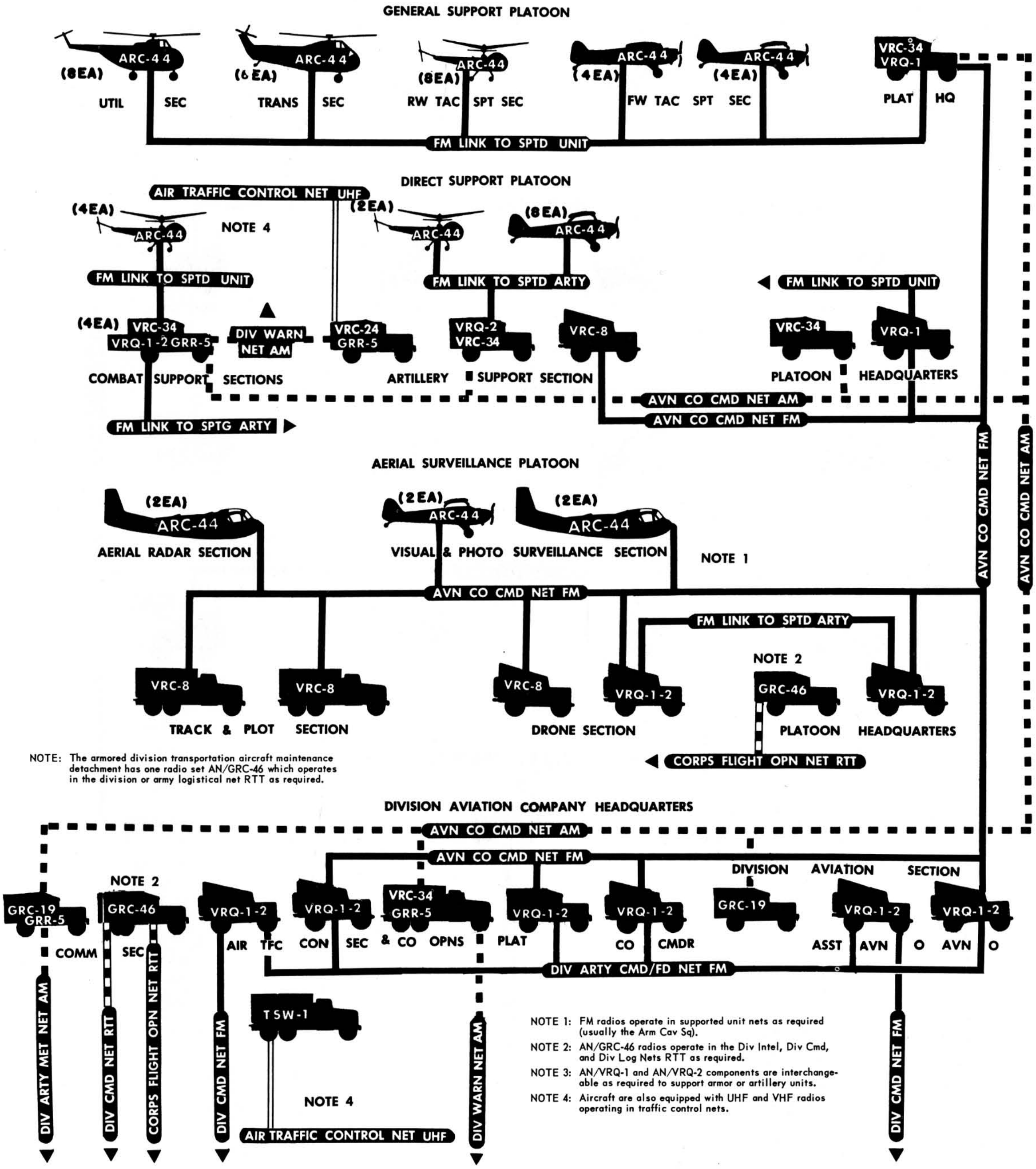
1. Division trains normally operate two stations in the division logistical net RTT, one of the command post and one of the division logistics control center (DLCC). One of these radio sets may be operated in the division command net RTT.
2. Division artillery headquarters may operate stations in the division intelligence net RTT and division logistical nets RTT when required, using radio sets normally operated in other nets.
3. Radio Set AN/GRC-26 mtd in Pers Carr may operate from Div Main as required.

Figure 77. Type radio net diagram, armored division.



NOTE: Liaison officers may operate in division staff net FM or in available command net FM of unit with which they are operating.

Figure 78. Type radio net diagram, armored division headquarters and headquarters company.



NOTE: The armored division transportation aircraft maintenance detachment has one radio set AN/GRC-46 which operates in the division or army logistical net RTT as required.

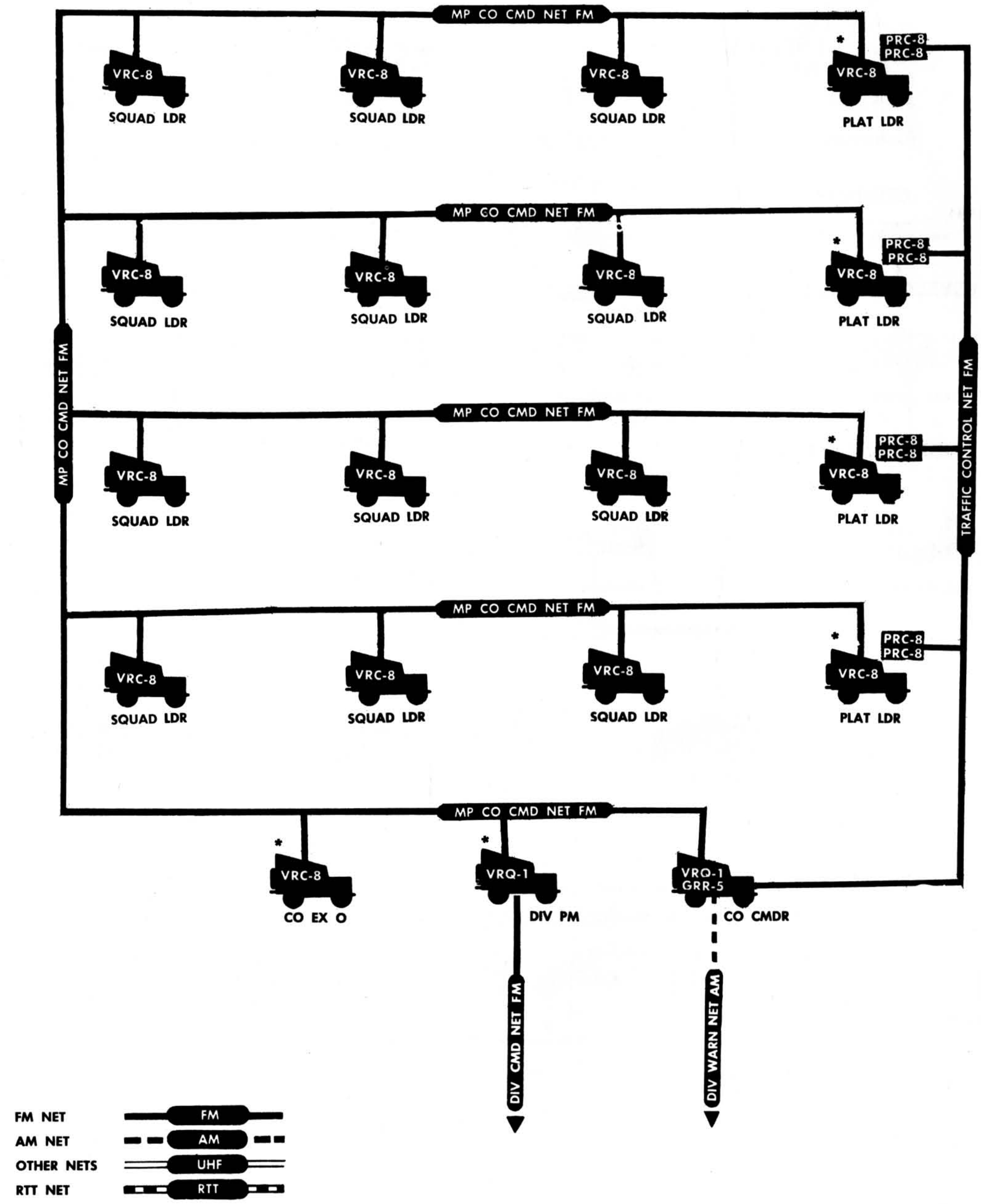
NOTE 1: FM radios operate in supported unit nets as required (usually the Arm Cav Sq).

NOTE 2: AN/GRC-46 radios operate in the Div Intel, Div Cmd, and Div Log Nets RTT as required.

NOTE 3: AN/VRQ-1 and AN/VRQ-2 components are interchangeable as required to support armor or artillery units.

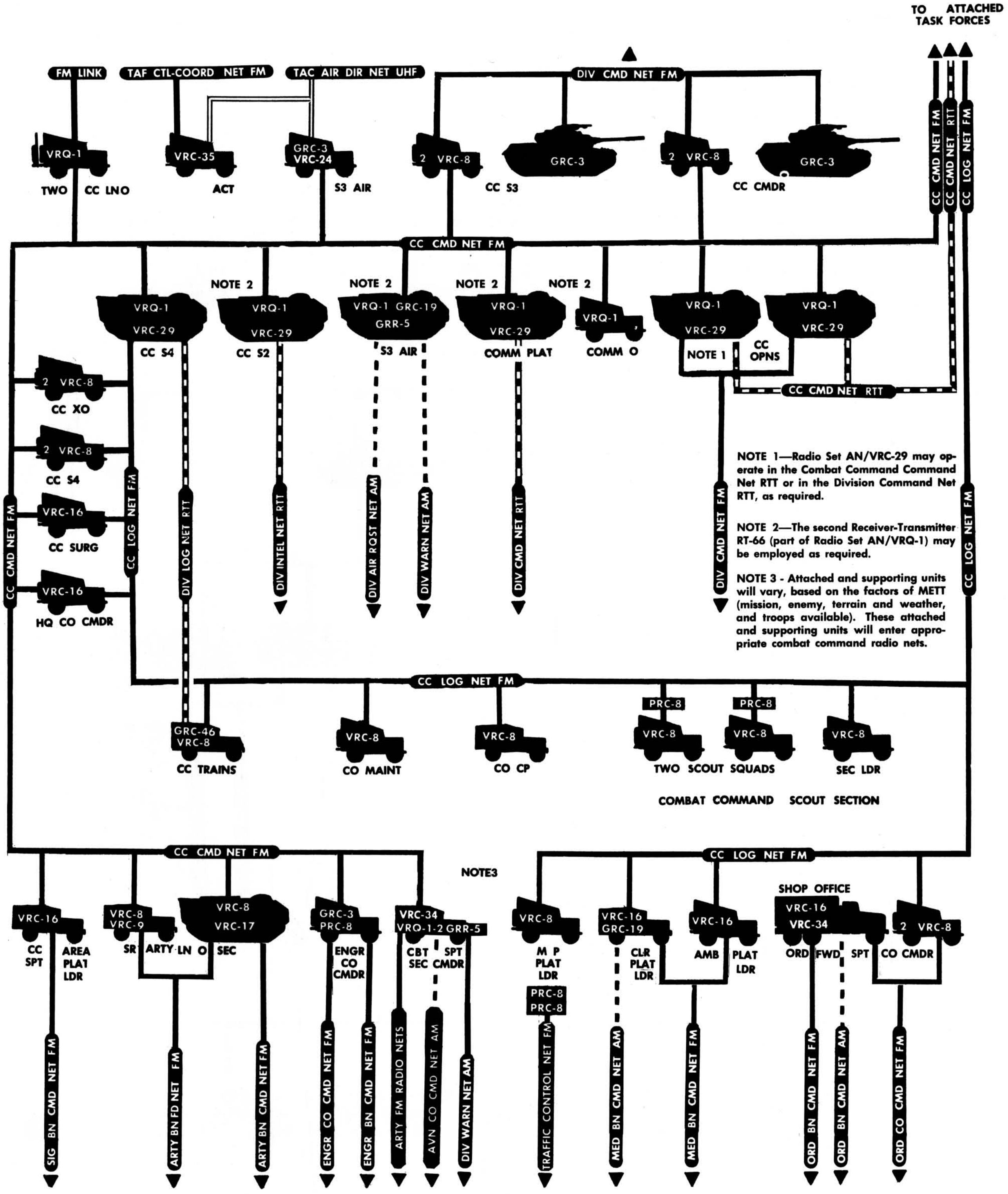
NOTE 4: Aircraft are also equipped with UHF and VHF radios operating in traffic control nets.

Figure 79. Type radio net diagram, armored division aviation company.



*NOTE: Vehicles marked with an asterisk mount a Radio Receiver R-110. This receiver may be used to monitor a traffic control net FM, or as a monitor in the command net of a unit with which the military police element is operating.

Figure 80. Type radio net diagram, armored division military police company.



NOTE 1—Radio Set AN/VRC-29 may operate in the Combat Command Command Net RTT or in the Division Command Net RTT, as required.

NOTE 2—The second Receiver-Transmitter RT-66 (part of Radio Set AN/VRQ-1) may be employed as required.

NOTE 3 - Attached and supporting units will vary, based on the factors of METT (mission, enemy, terrain and weather, and troops available). These attached and supporting units will enter appropriate combat command radio nets.

Figure 81. Type radio net diagram, headquarters and headquarters company, armored division combat command, with normal attached and supporting units.

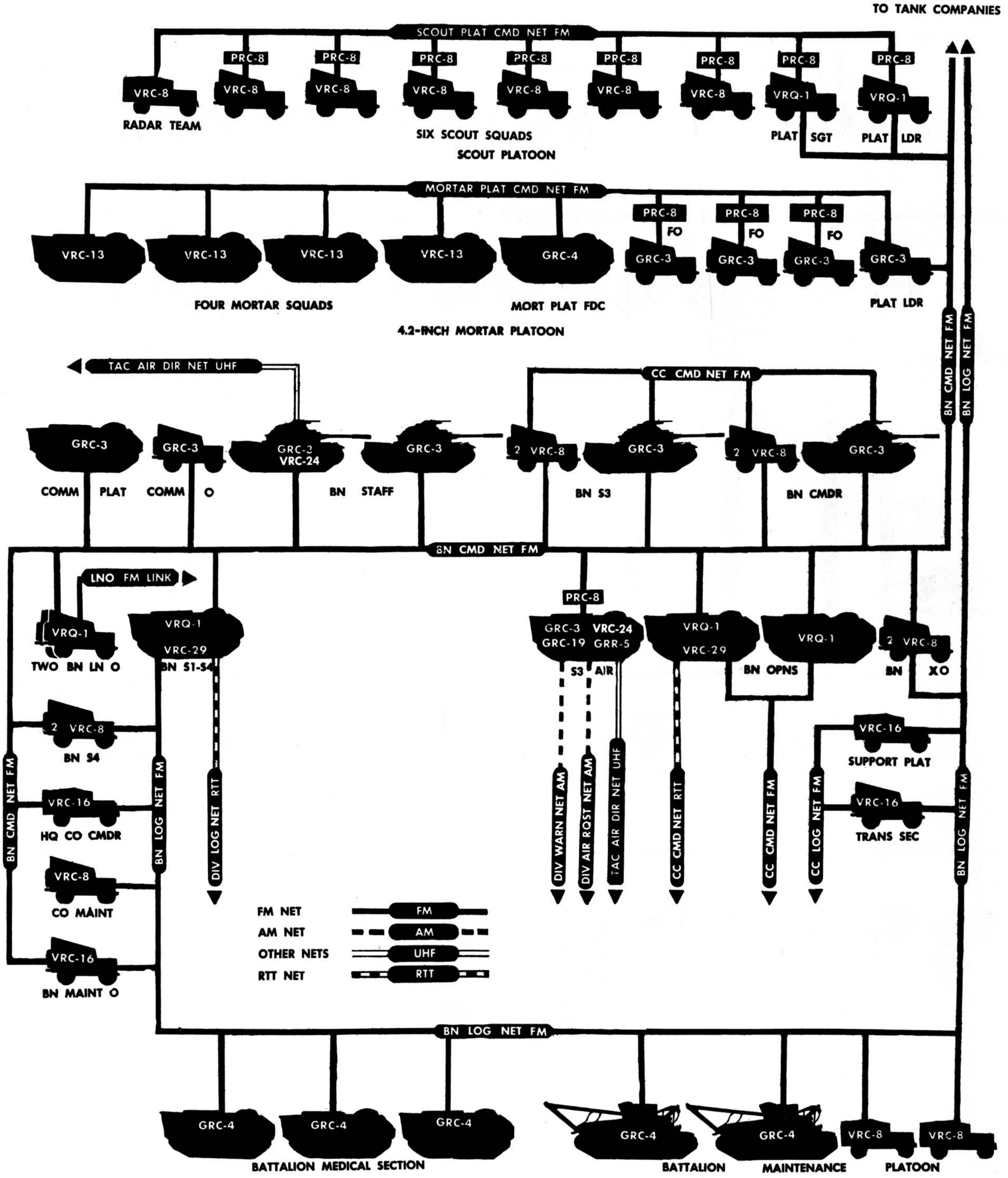


Figure 82. Type radio net diagram, headquarters and headquarters company, armored division armor battalion, 90-mm.

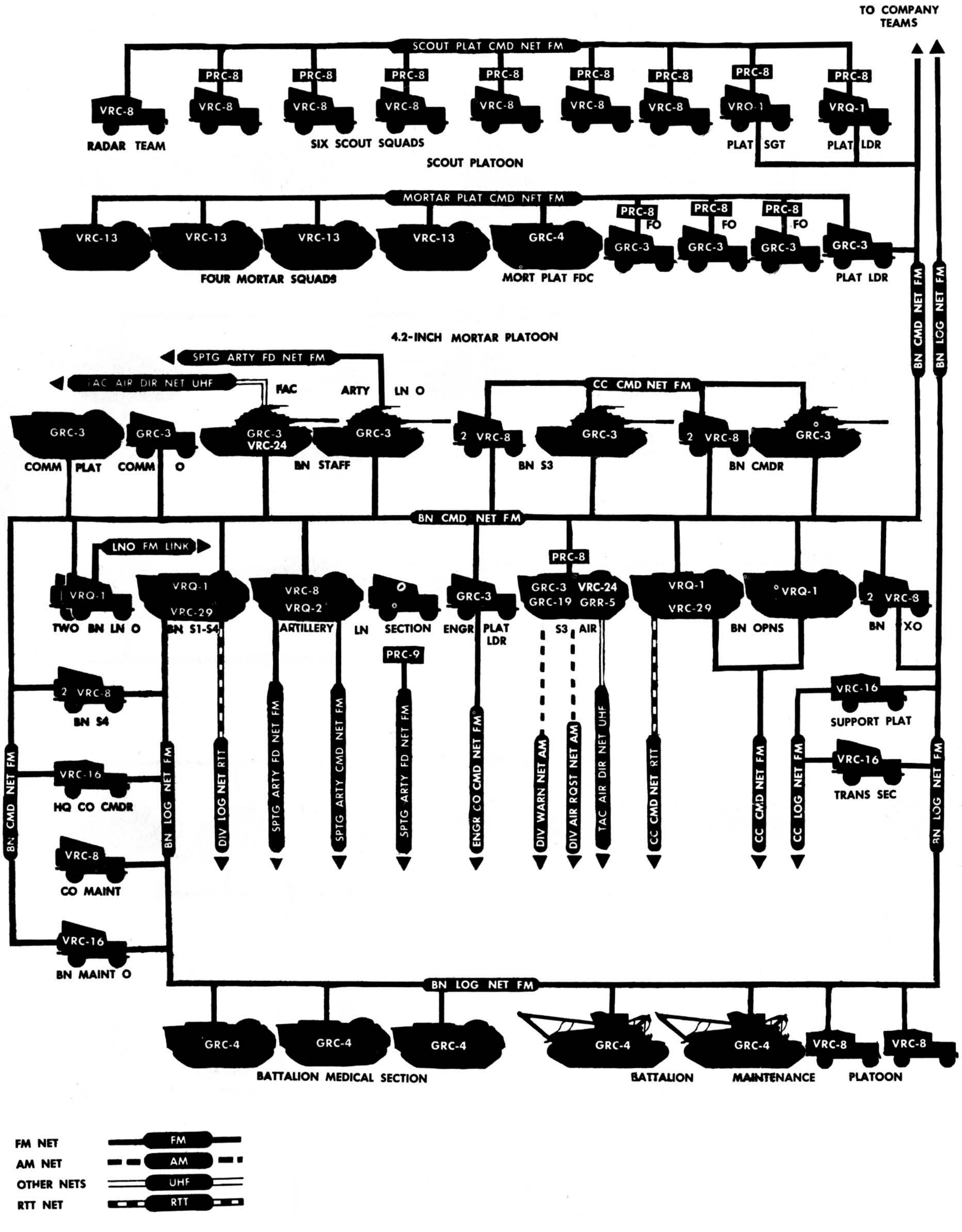


Figure 83. Type radio net diagram, armored division armor battalion task force.

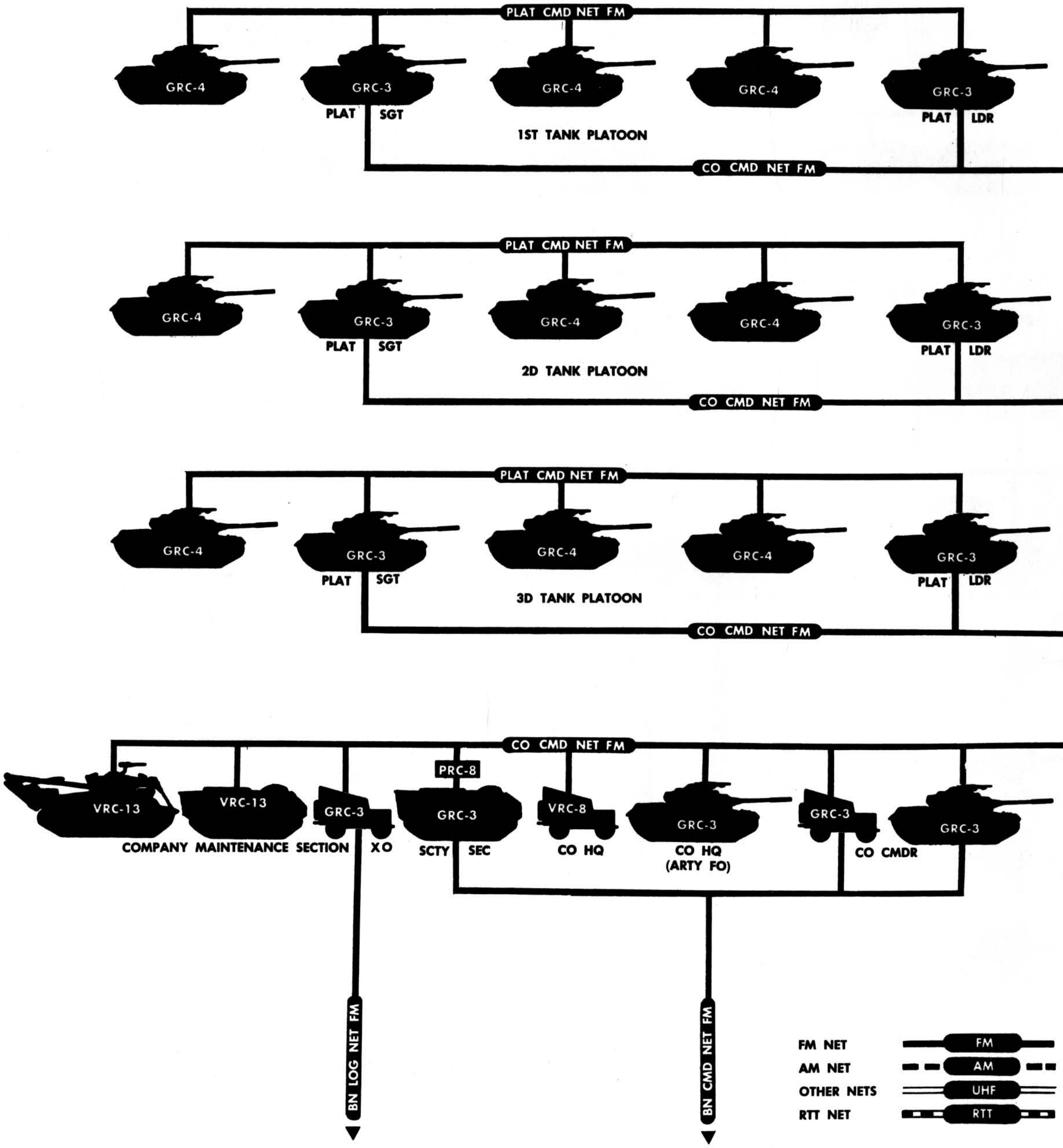


Figure 84. Type radio net diagram, medium tank company, armored division armor battalion, 90-mm.

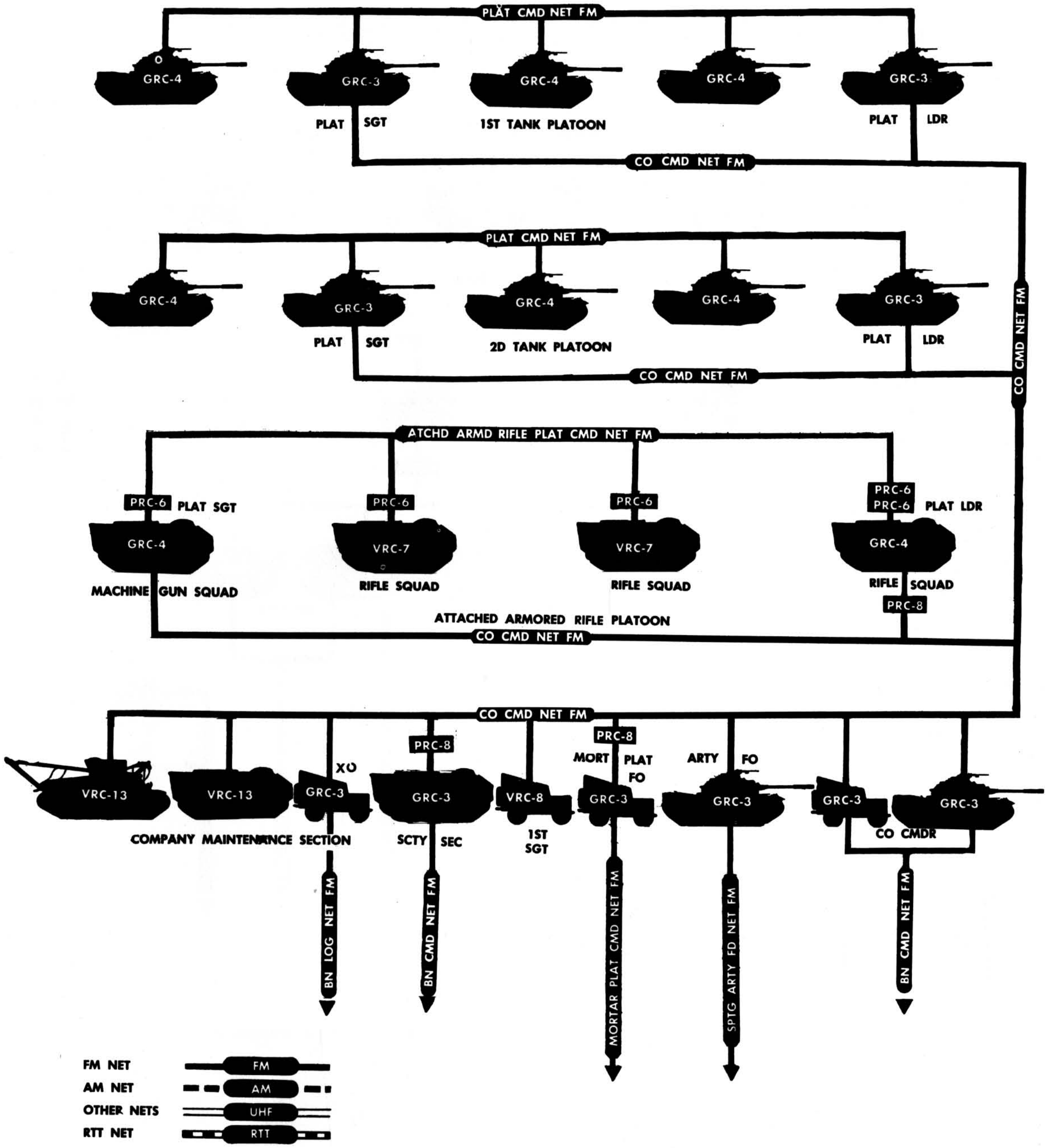


Figure 85. Type radio net diagram, medium tank company team, armored division, armor battalion.

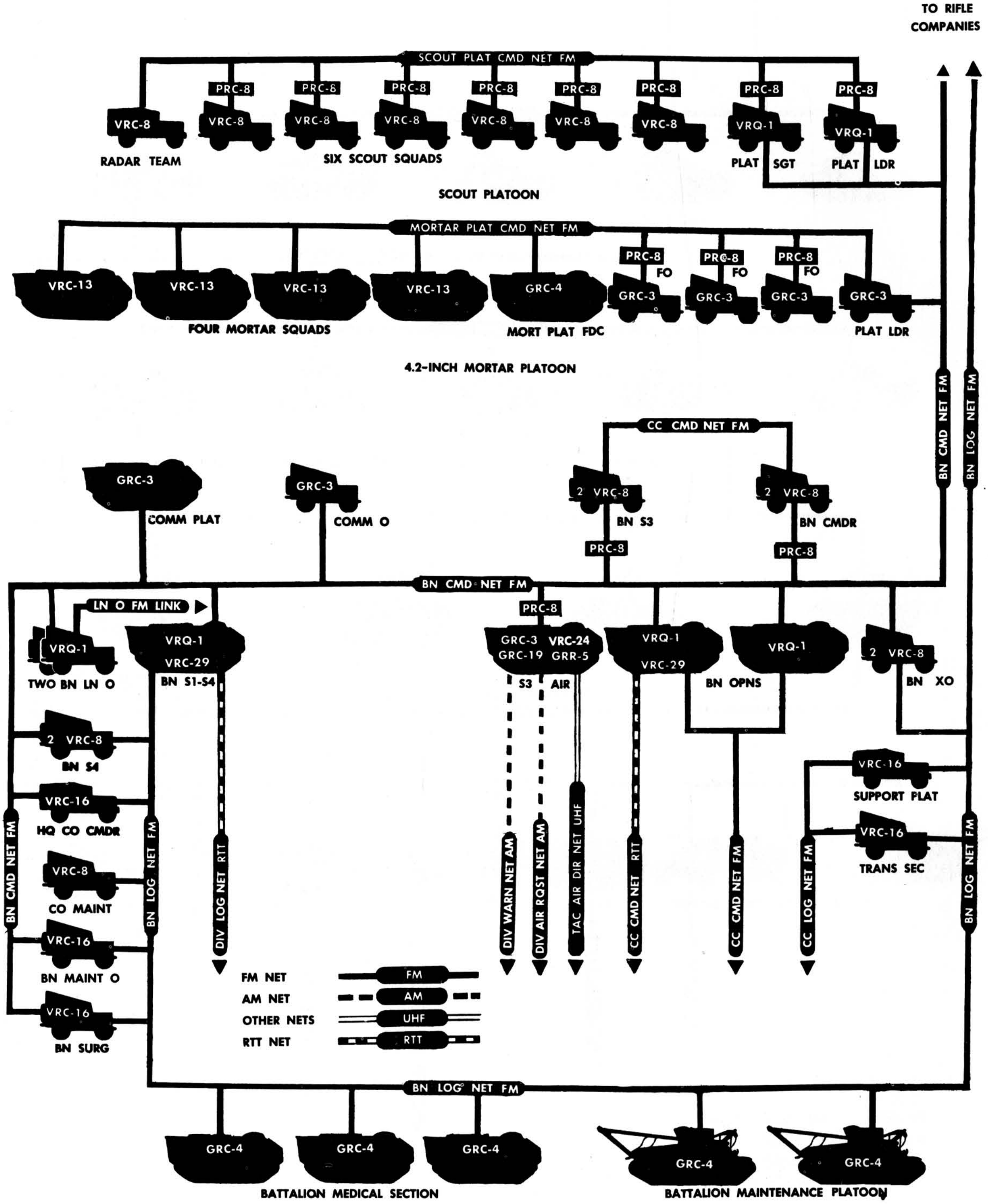


Figure 86. Type radio net diagram, headquarters and headquarters company, armored infantry battalion, armored division.

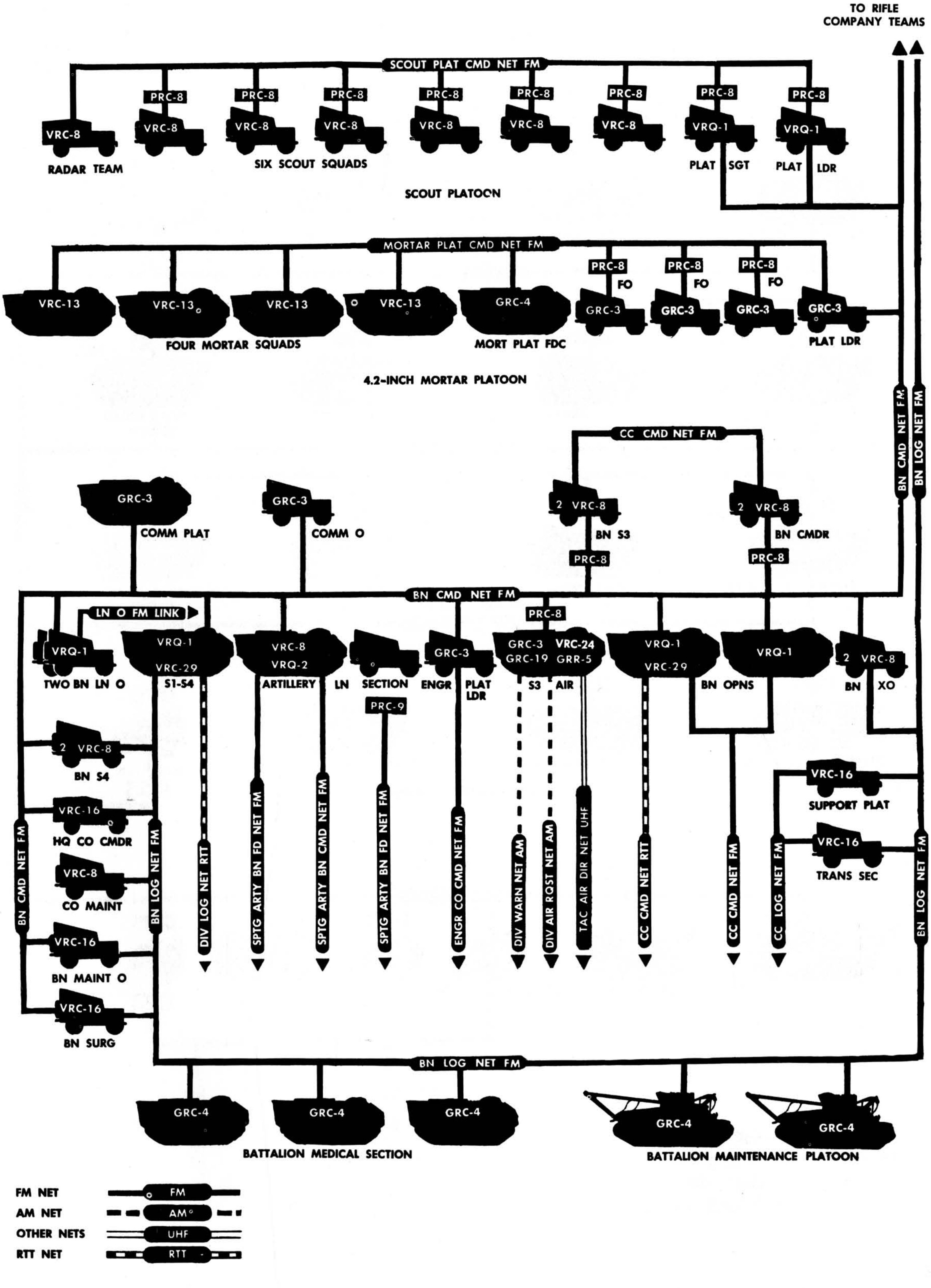


Figure 87. Type radio net diagram, armored infantry battalion task force, armored division.

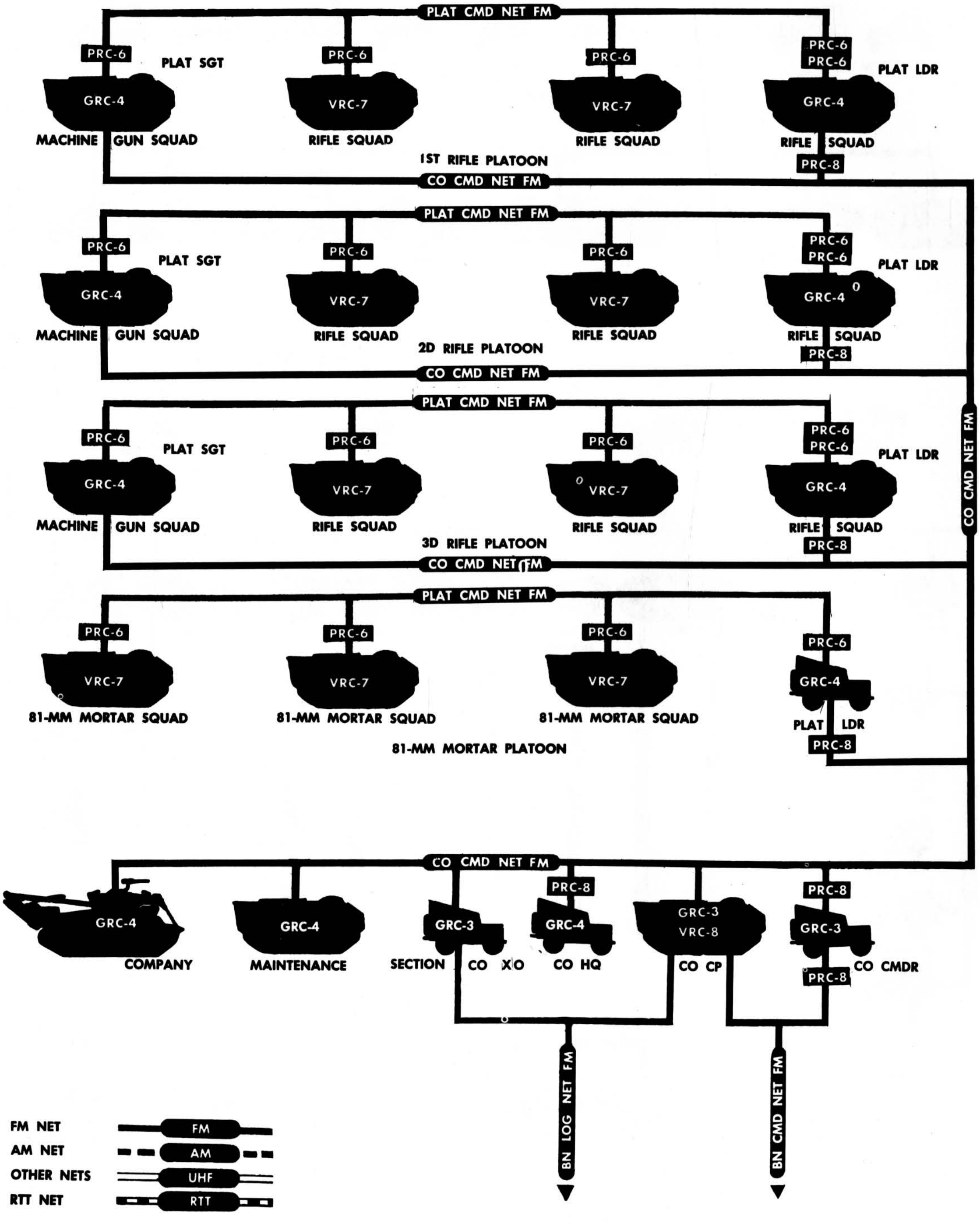


Figure 88. Type radio net diagram, rifle company, armored infantry battalion.

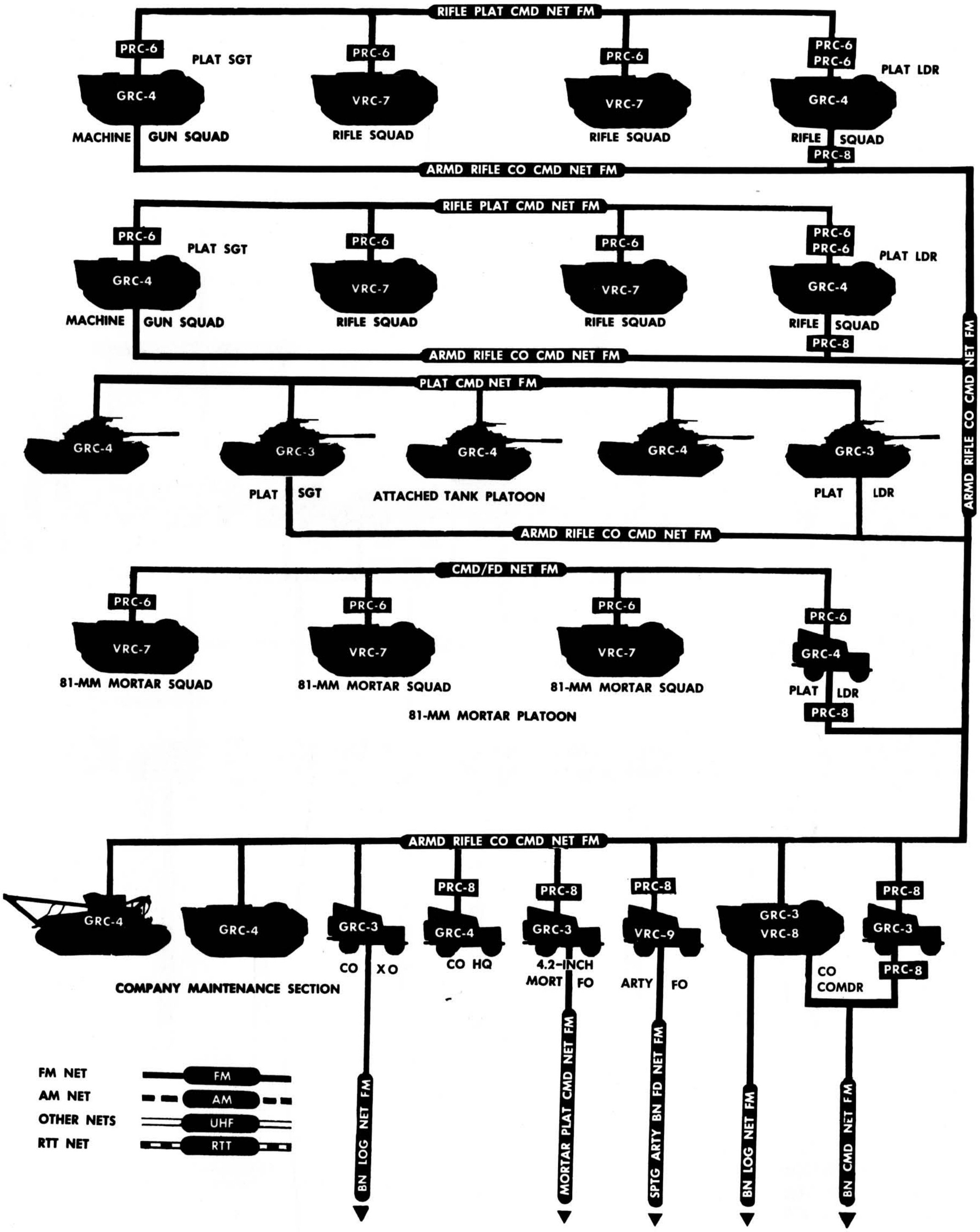
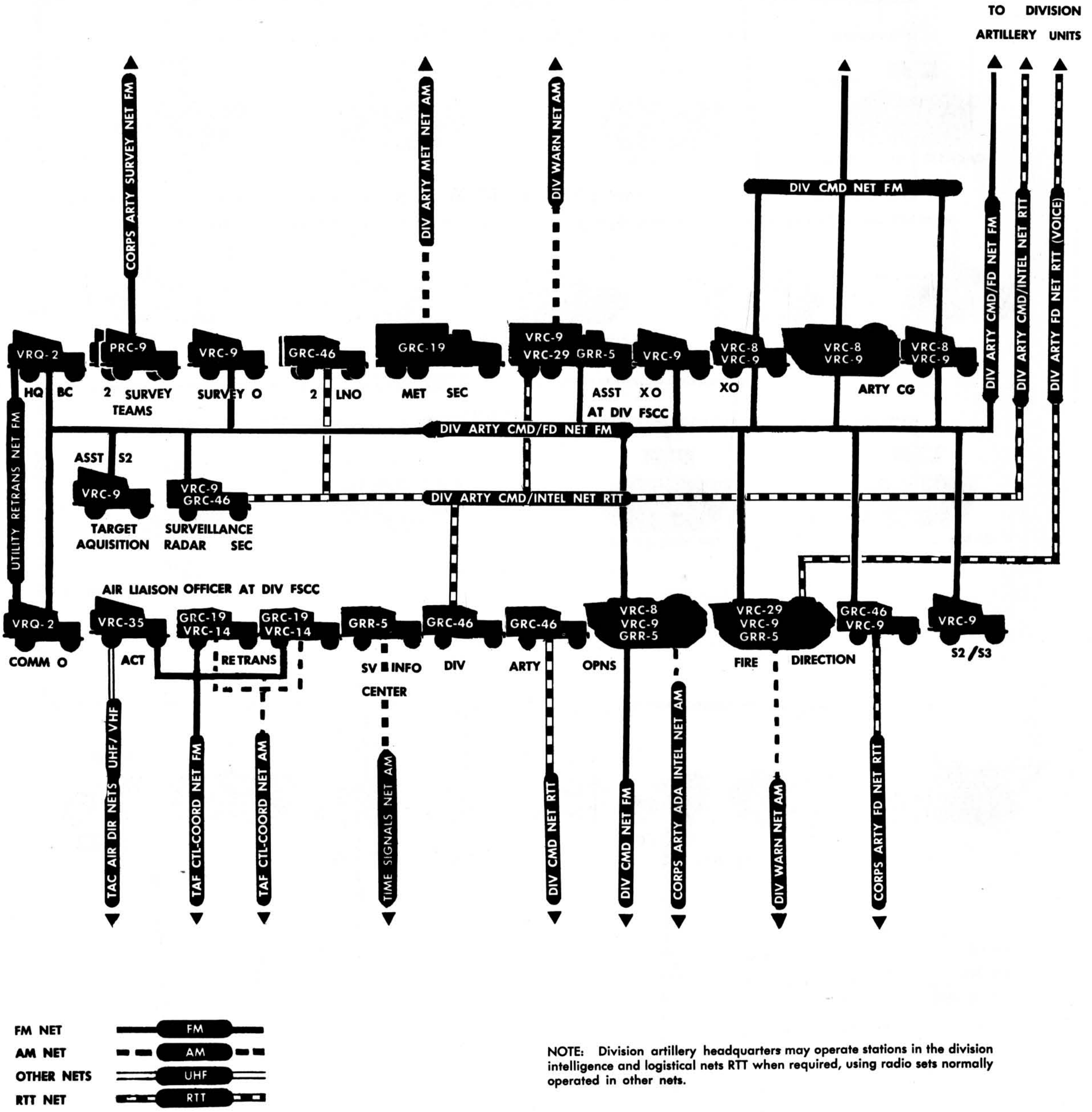
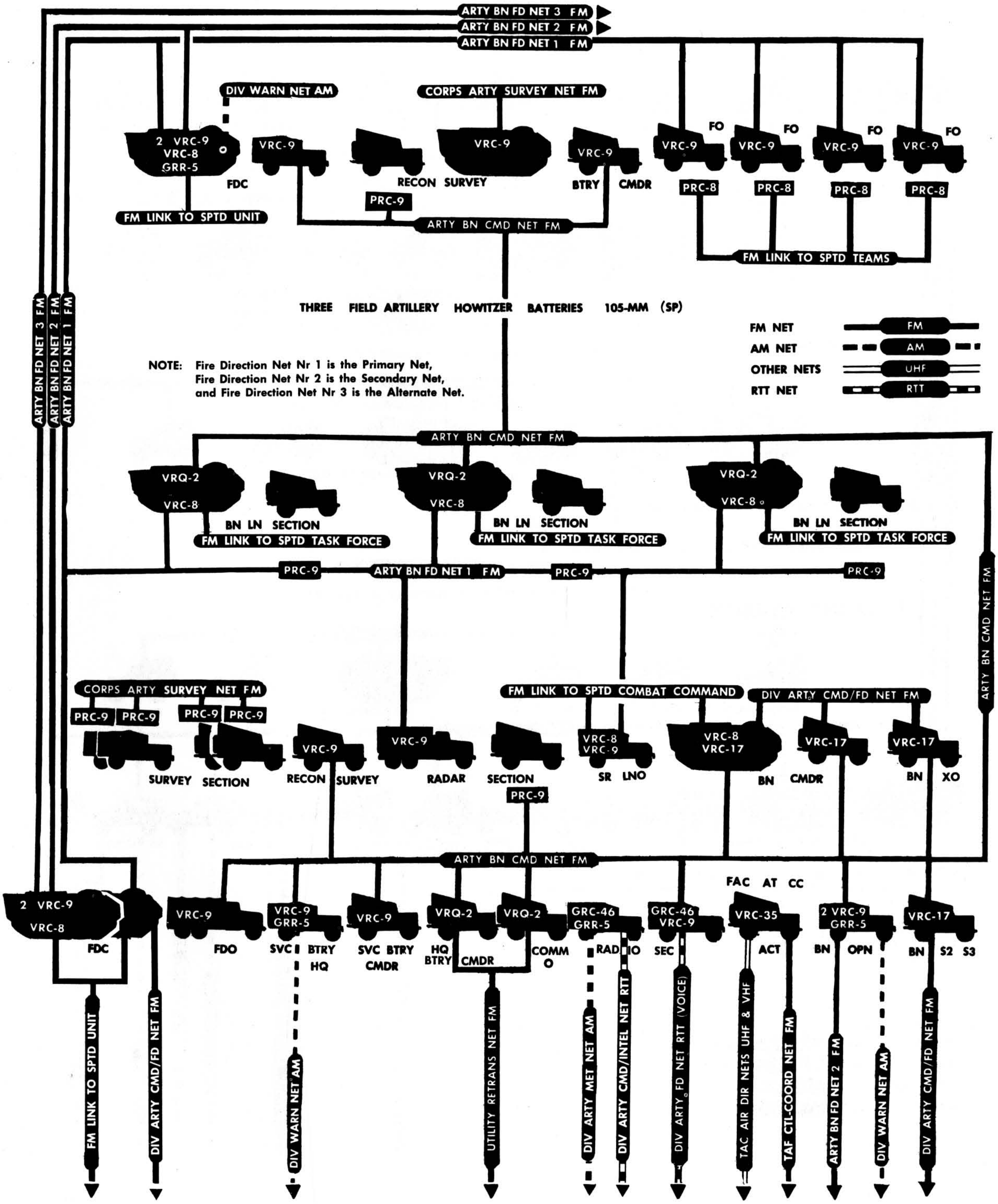


Figure 89. Type radio net diagram, rifle company team armored infantry battalion, armored division.



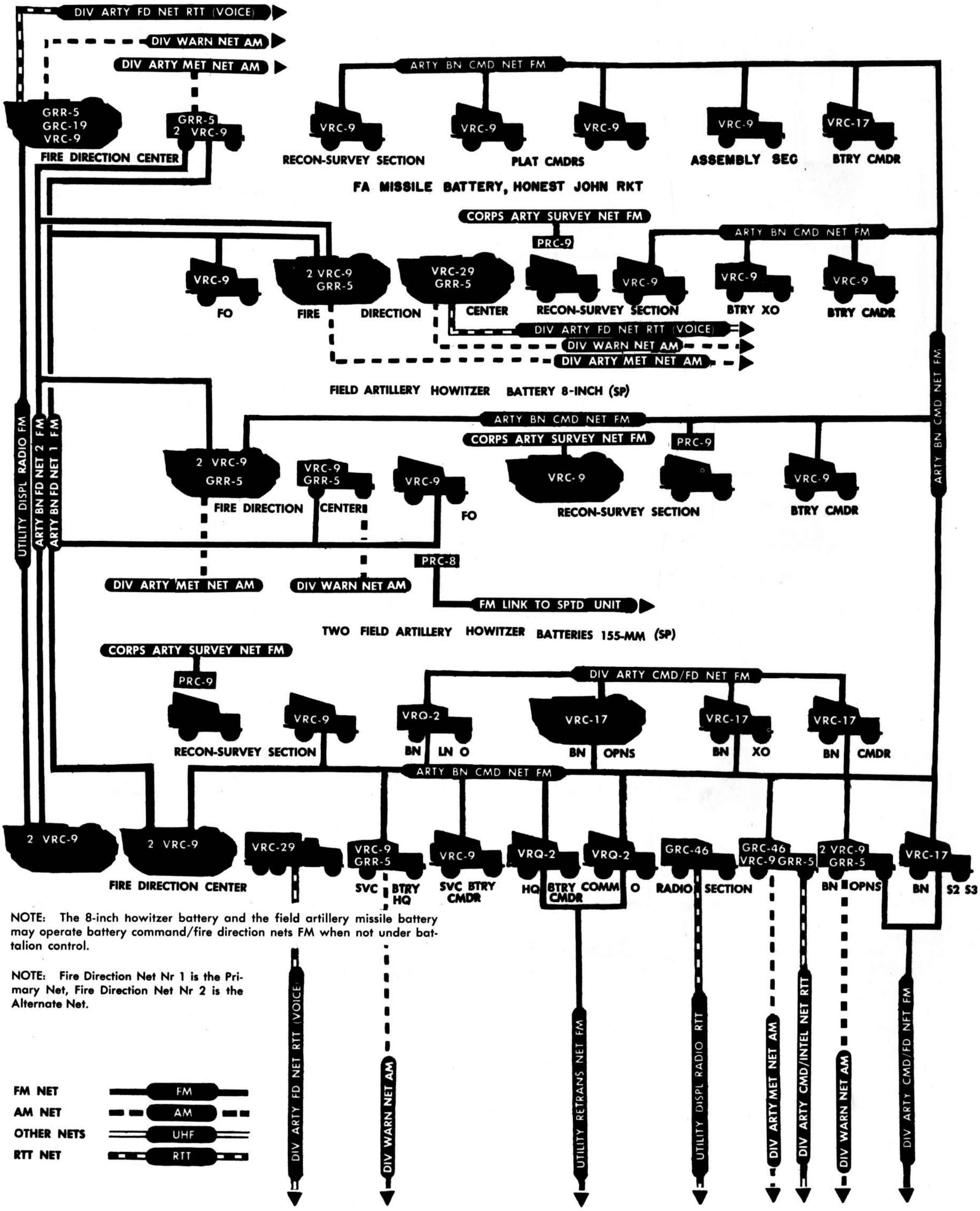
NOTE: Division artillery headquarters may operate stations in the division intelligence and logistical nets RTT when required, using radio sets normally operated in other nets.

Figure 90. Type radio net diagram, headquarters and headquarters battery, armored division artillery.



NOTE: Fire Direction Net Nr 1 is the Primary Net, Fire Direction Net Nr 2 is the Secondary Net, and Fire Direction Net Nr 3 is the Alternate Net.

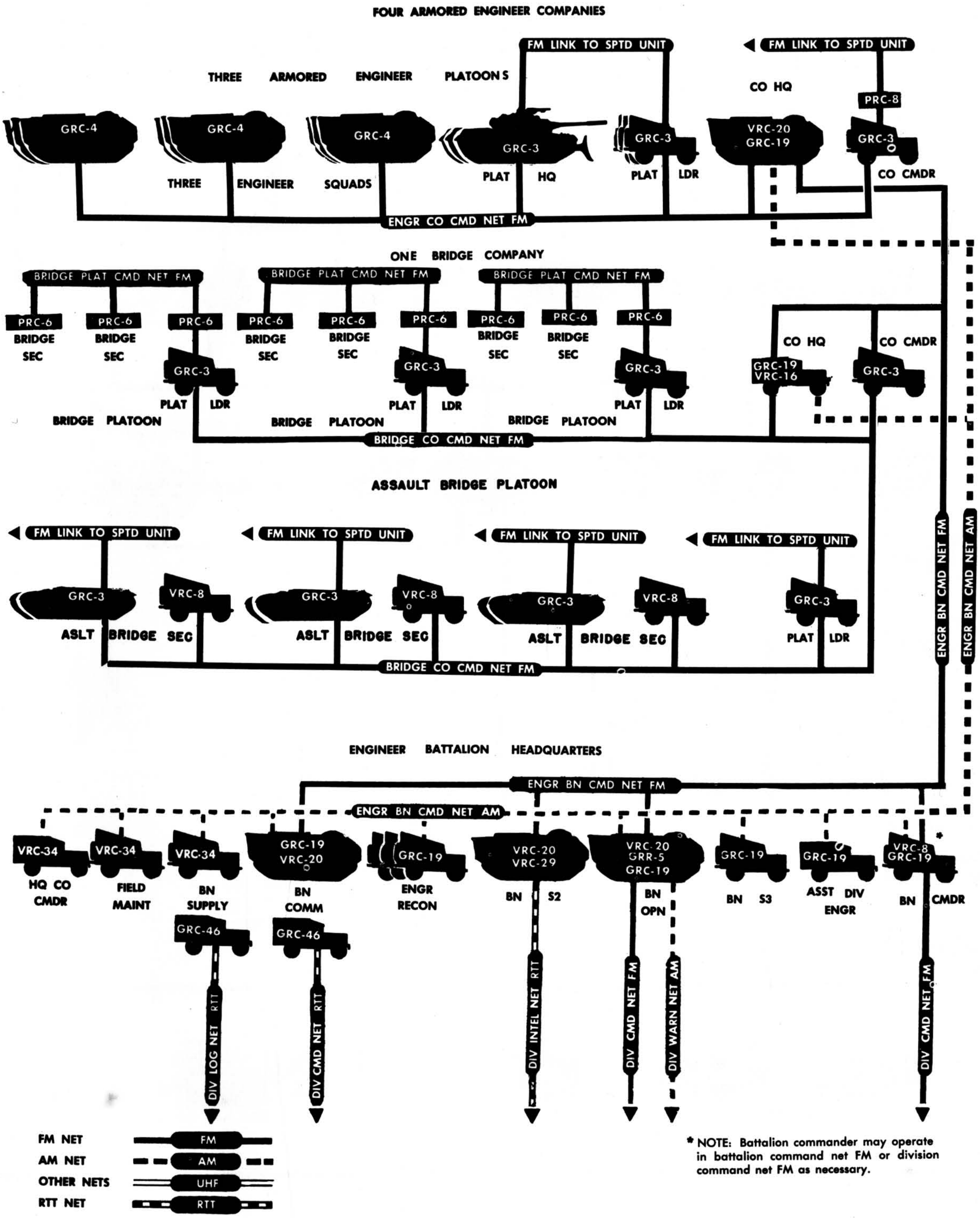
Figure 91. Type radio net diagram, field artillery howitzer battalion, 105-mm (SP).



NOTE: The 8-inch howitzer battery and the field artillery missile battery may operate battery command/fire direction nets FM when not under battalion control.

NOTE: Fire Direction Net Nr 1 is the Primary Net, Fire Direction Net Nr 2 is the Alternate Net.

Figure 92. Type radio net diagram, armored division field artillery rocket-howitzer battalion.



* NOTE: Battalion commander may operate in battalion command net FM or division command net FM as necessary.

Figure 93. Type radio net diagram, armored division engineer battalion.

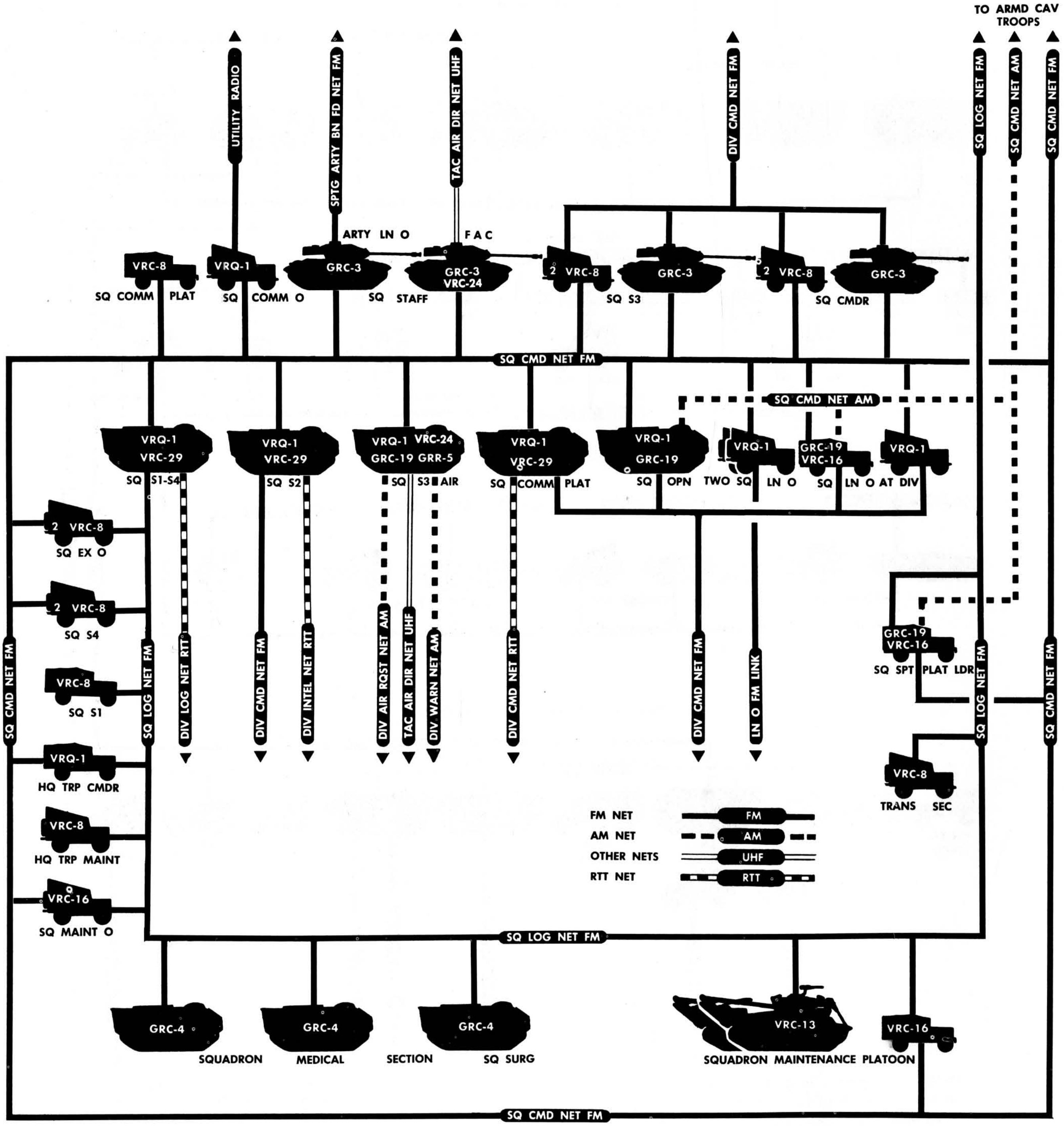


Figure 94. Type radio net diagram, headquarters and headquarters troop, armored division cavalry squadron.

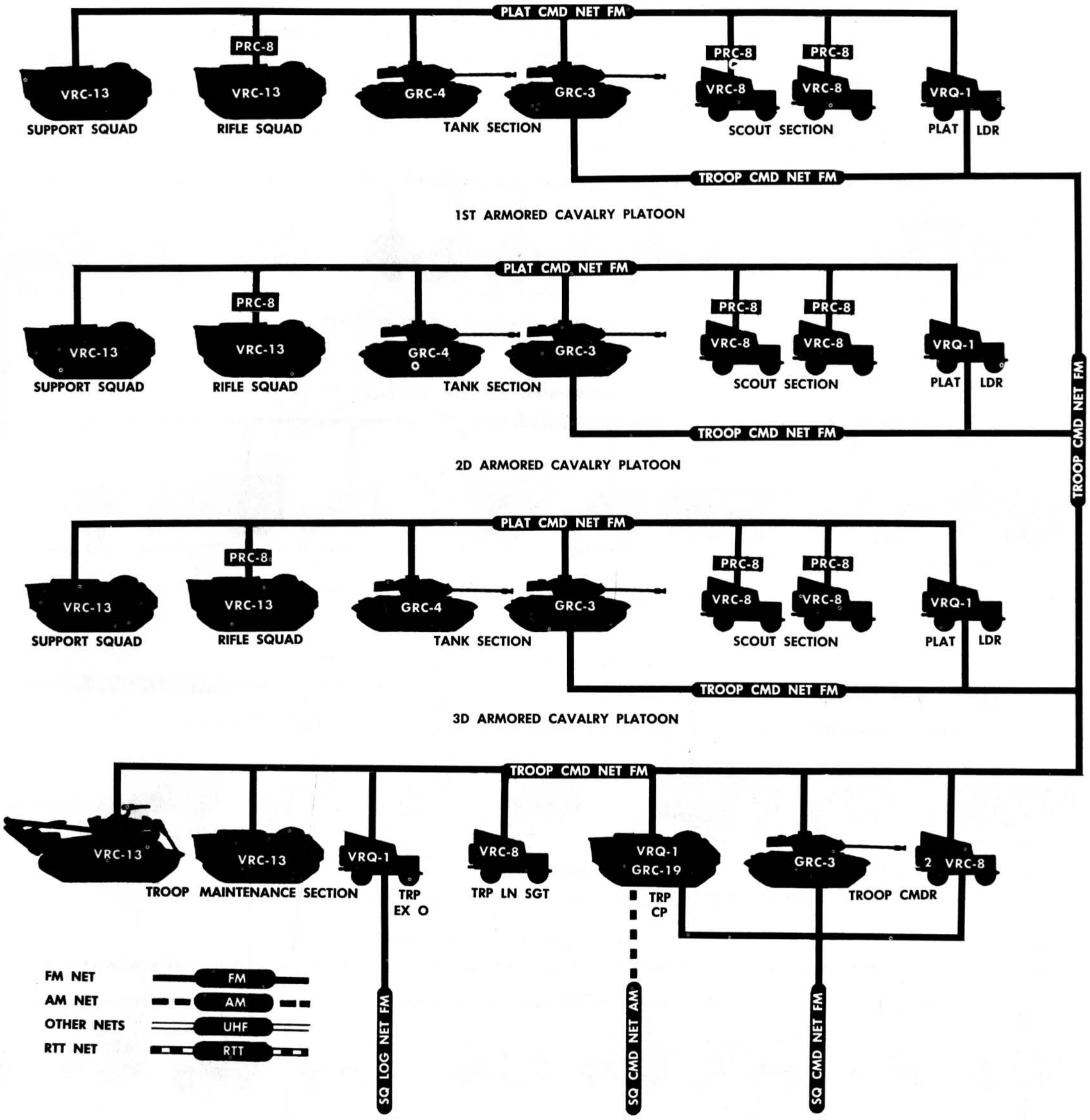
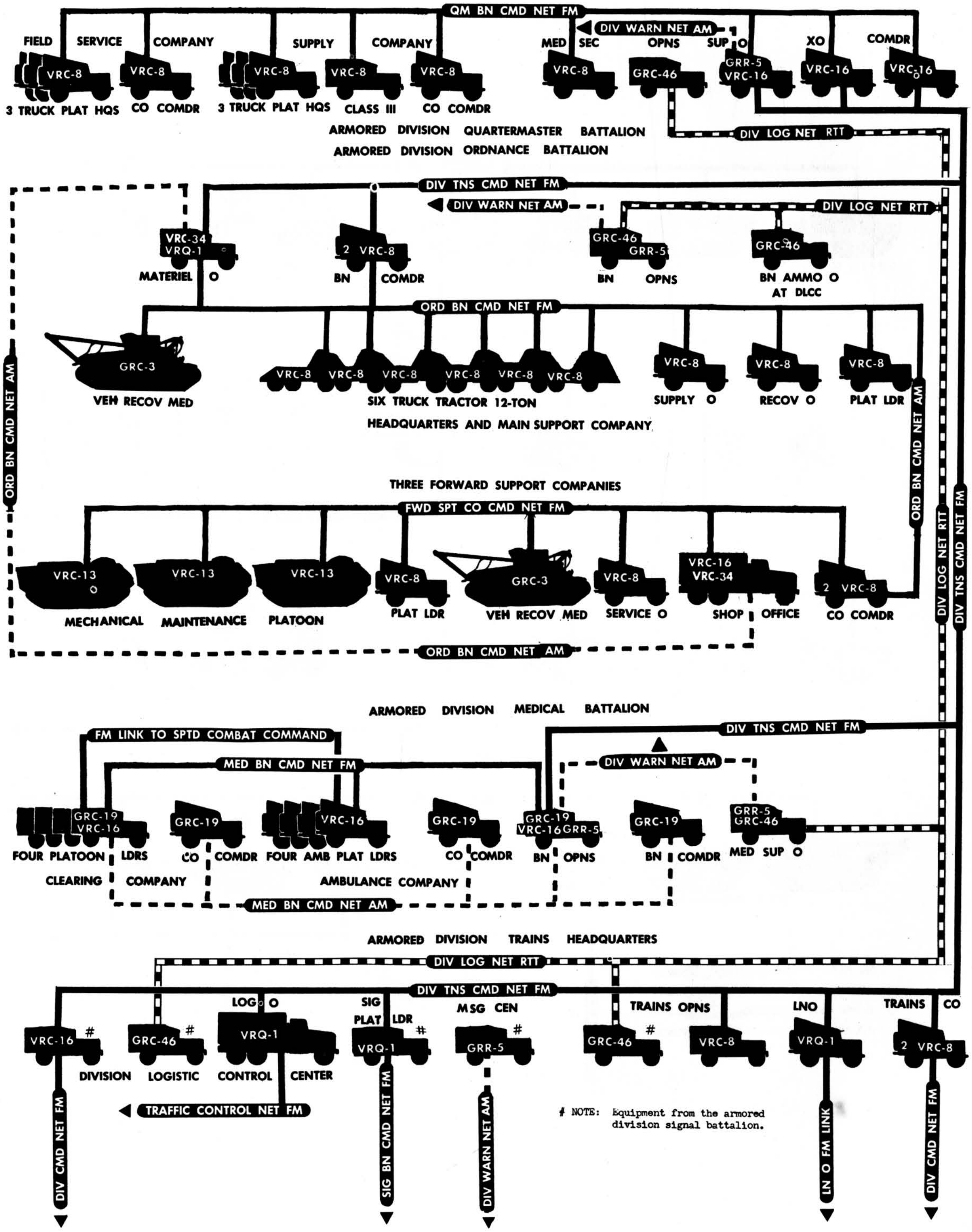


Figure 95. Type radio net diagram, armored cavalry troop, armored cavalry squadron, armored division.



NOTE: Equipment from the armored division signal battalion.

Figure 96. Type radio net diagram, armored division trains.

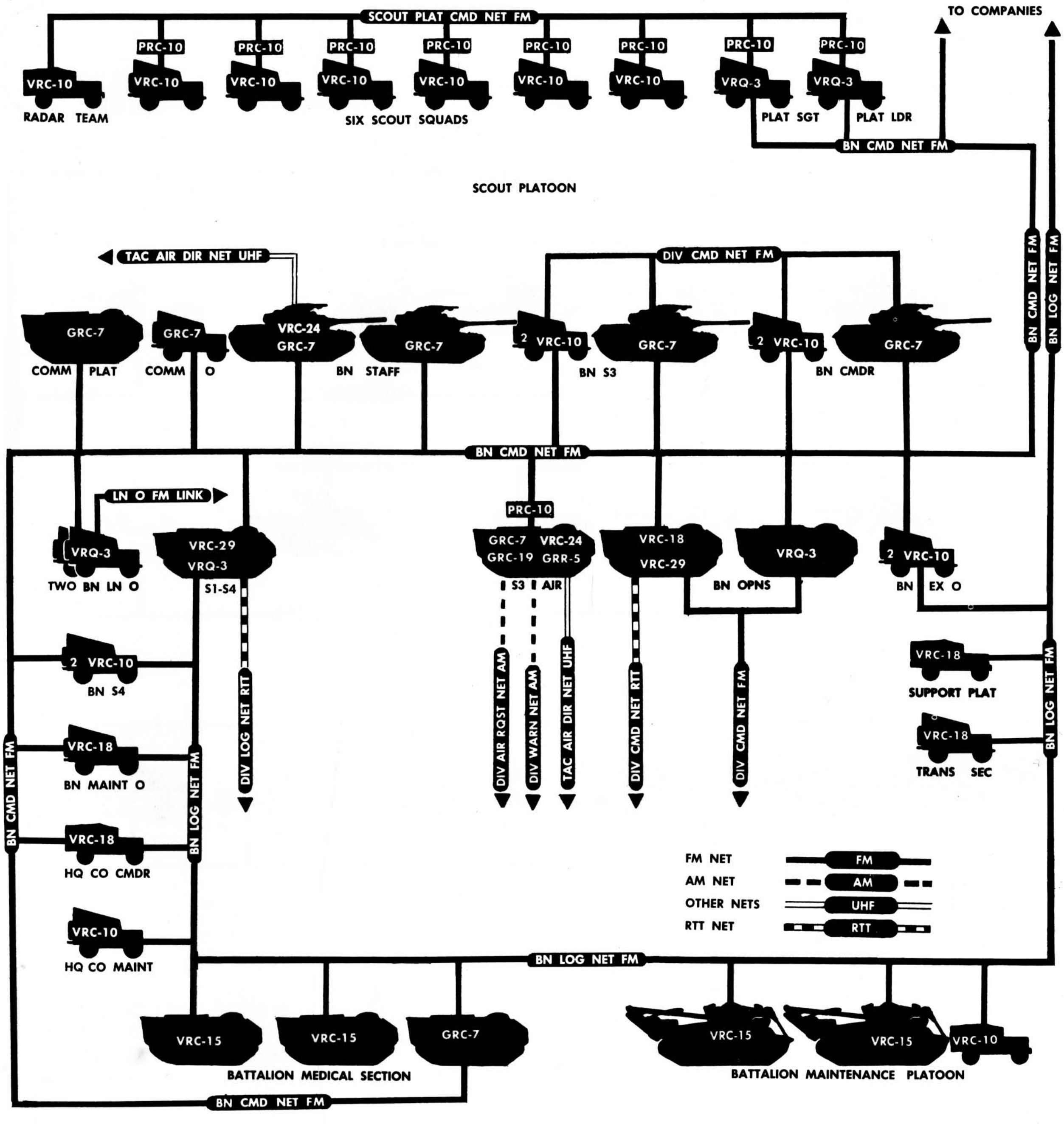


Figure 97. Type radio net diagram, headquarters and headquarters company, infantry division armor battalion, 90-mm.

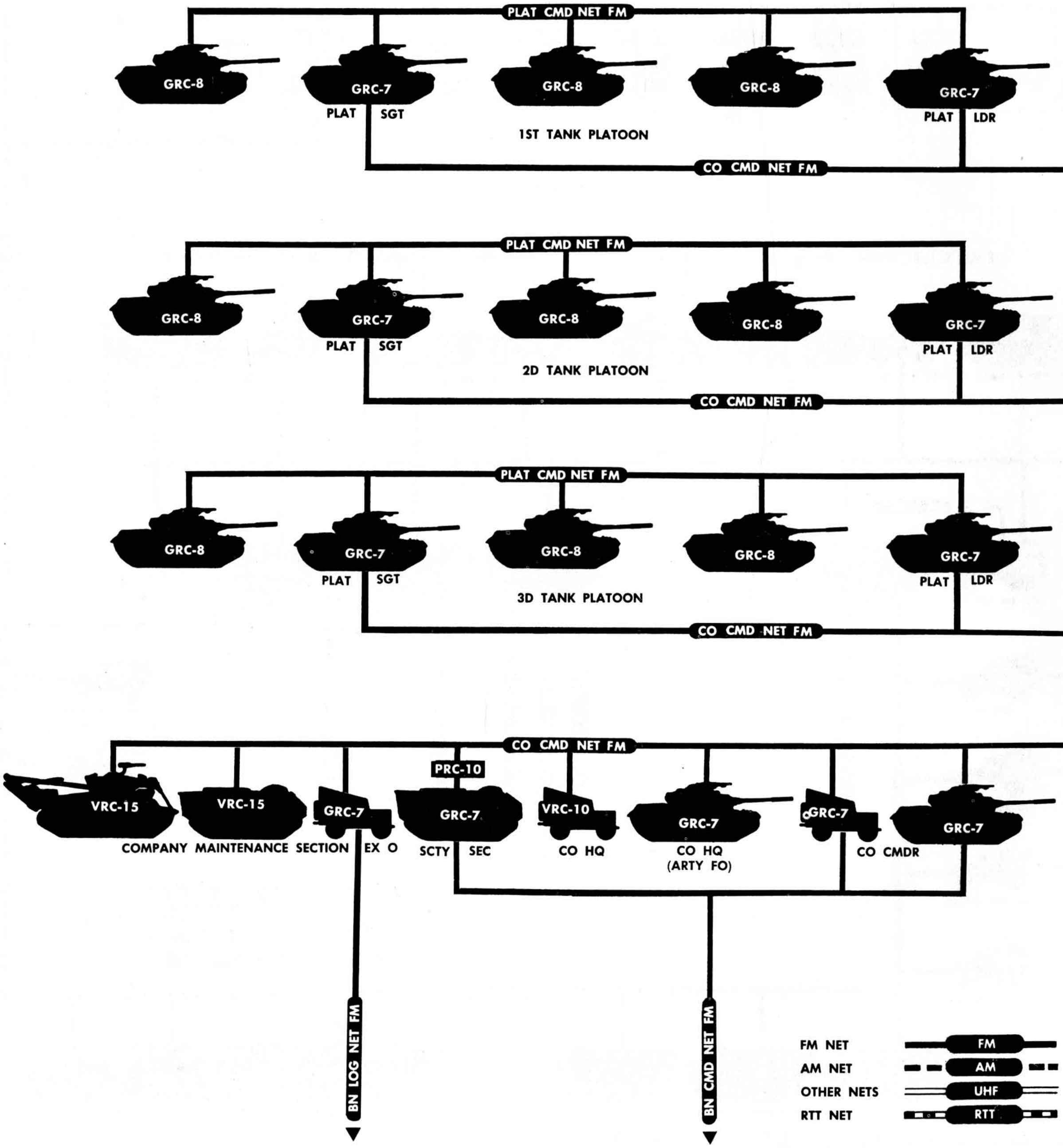


Figure 98. *Type radio net diagram, medium tank company, infantry division armor battalion, 90-mm.*

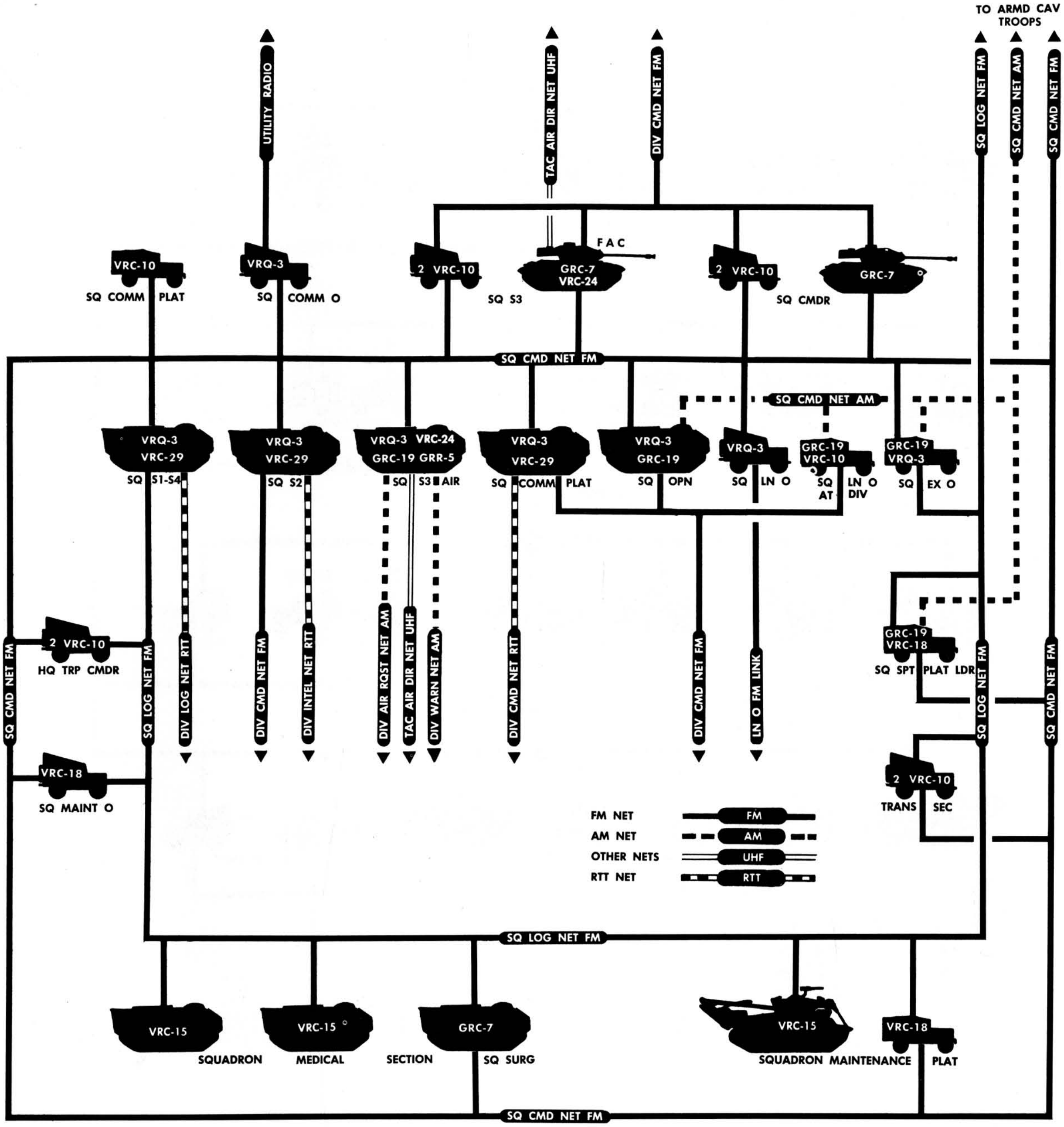


Figure 99. Type radio net diagram, headquarters and headquarters troop, infantry division cavalry squadron.

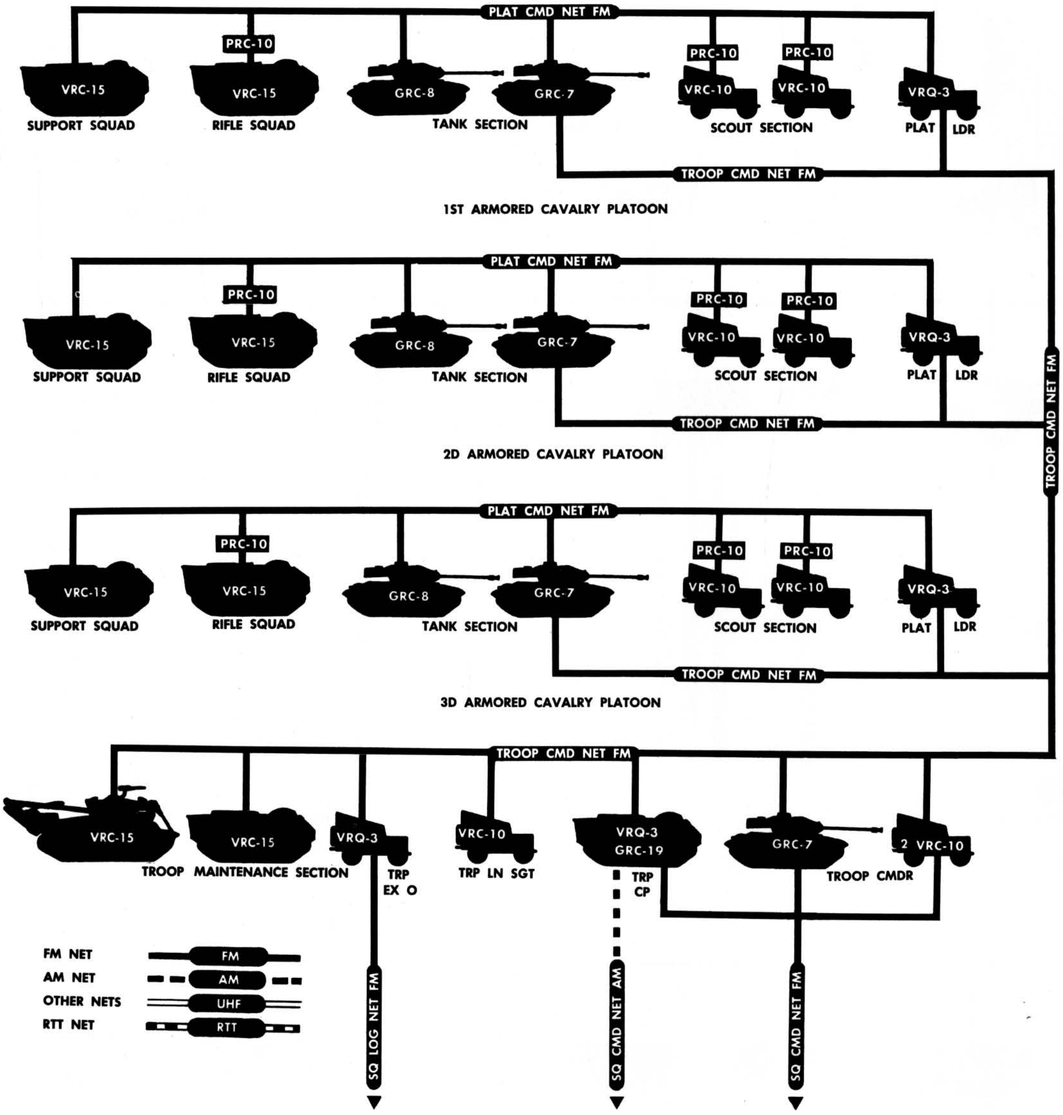


Figure 100. *Type radio net diagram, armored cavalry troop, infantry division cavalry squadron.*

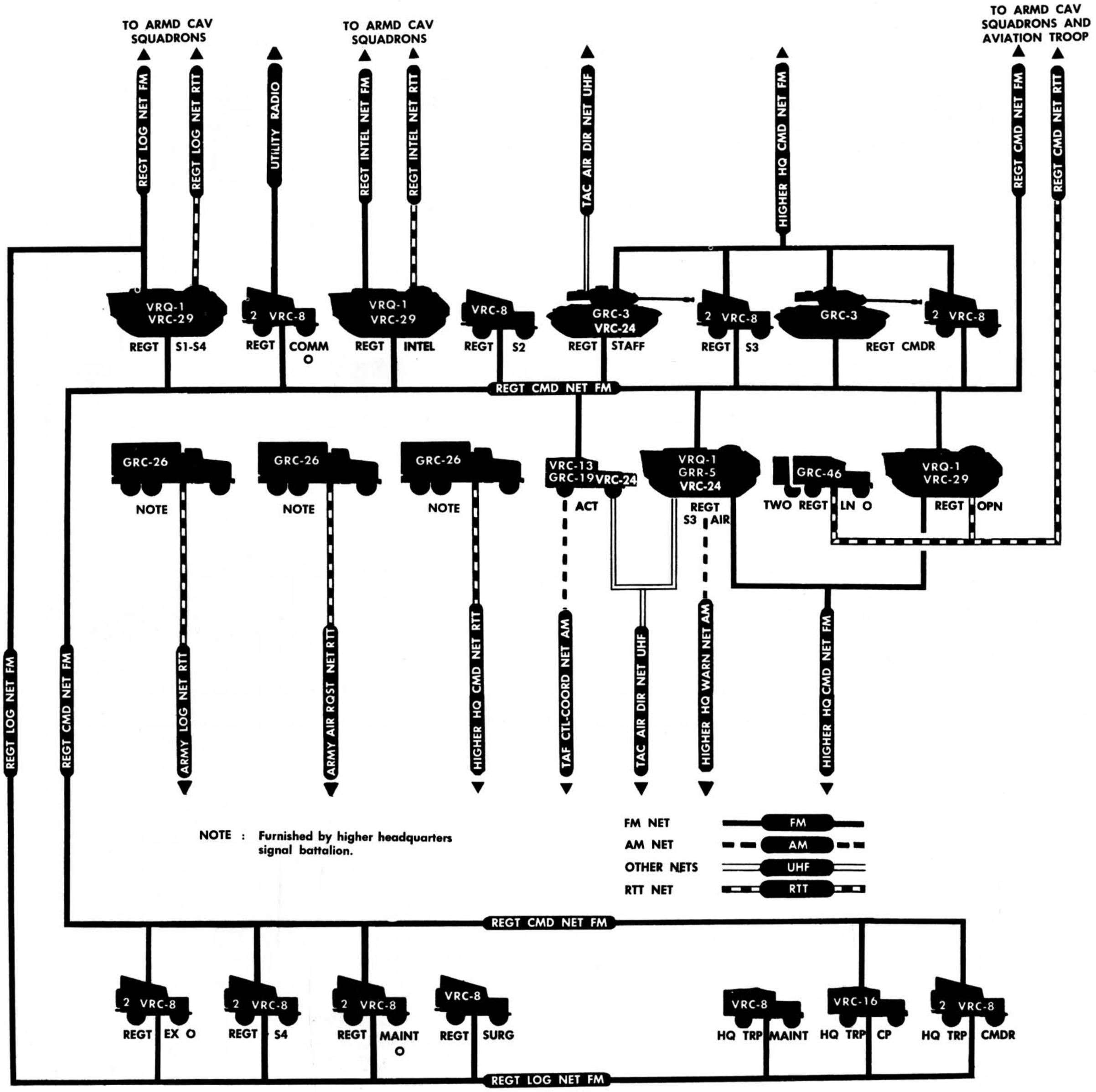


Figure 101. Type radio net diagram, headquarters and headquarters troop, armored cavalry regiment.

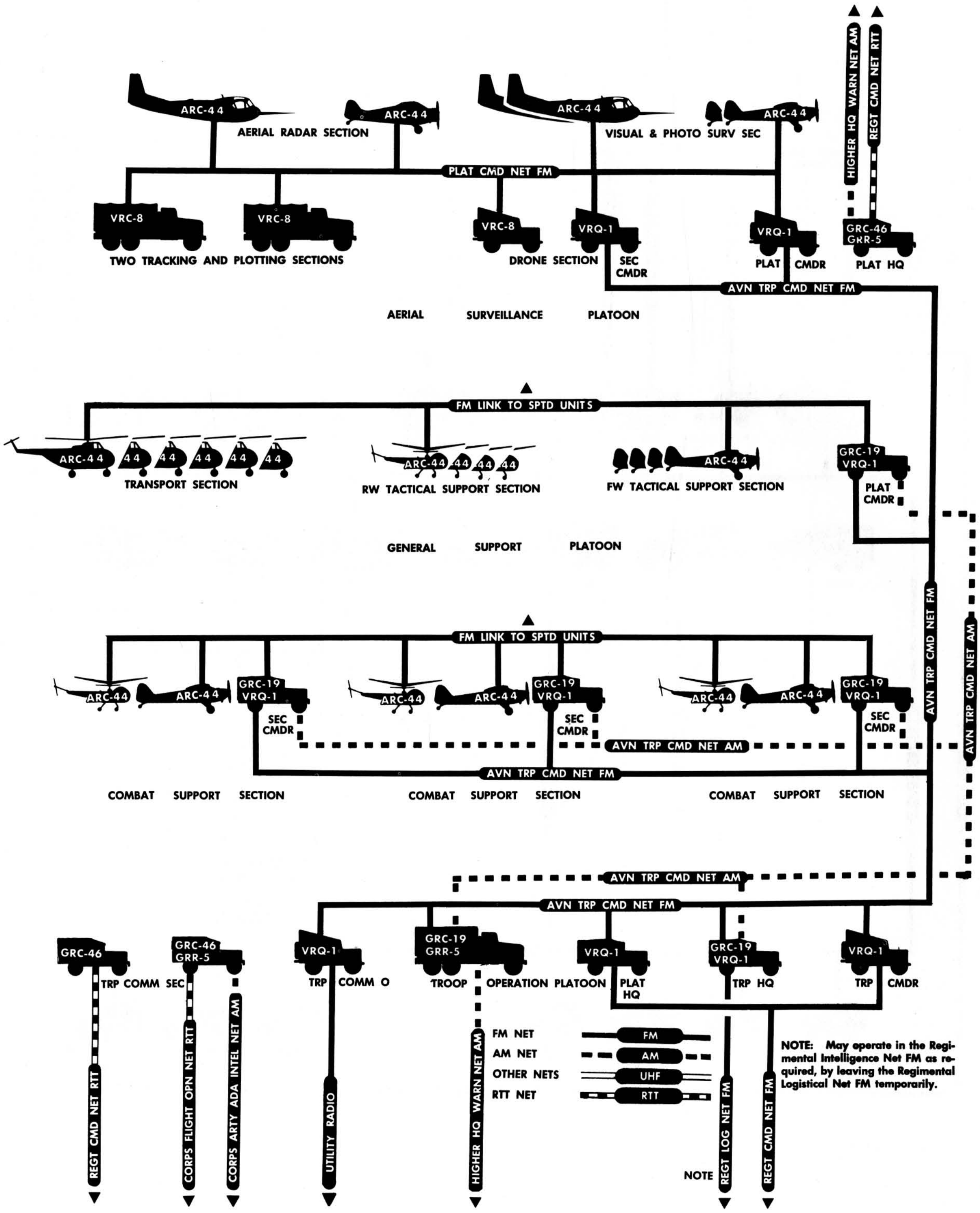
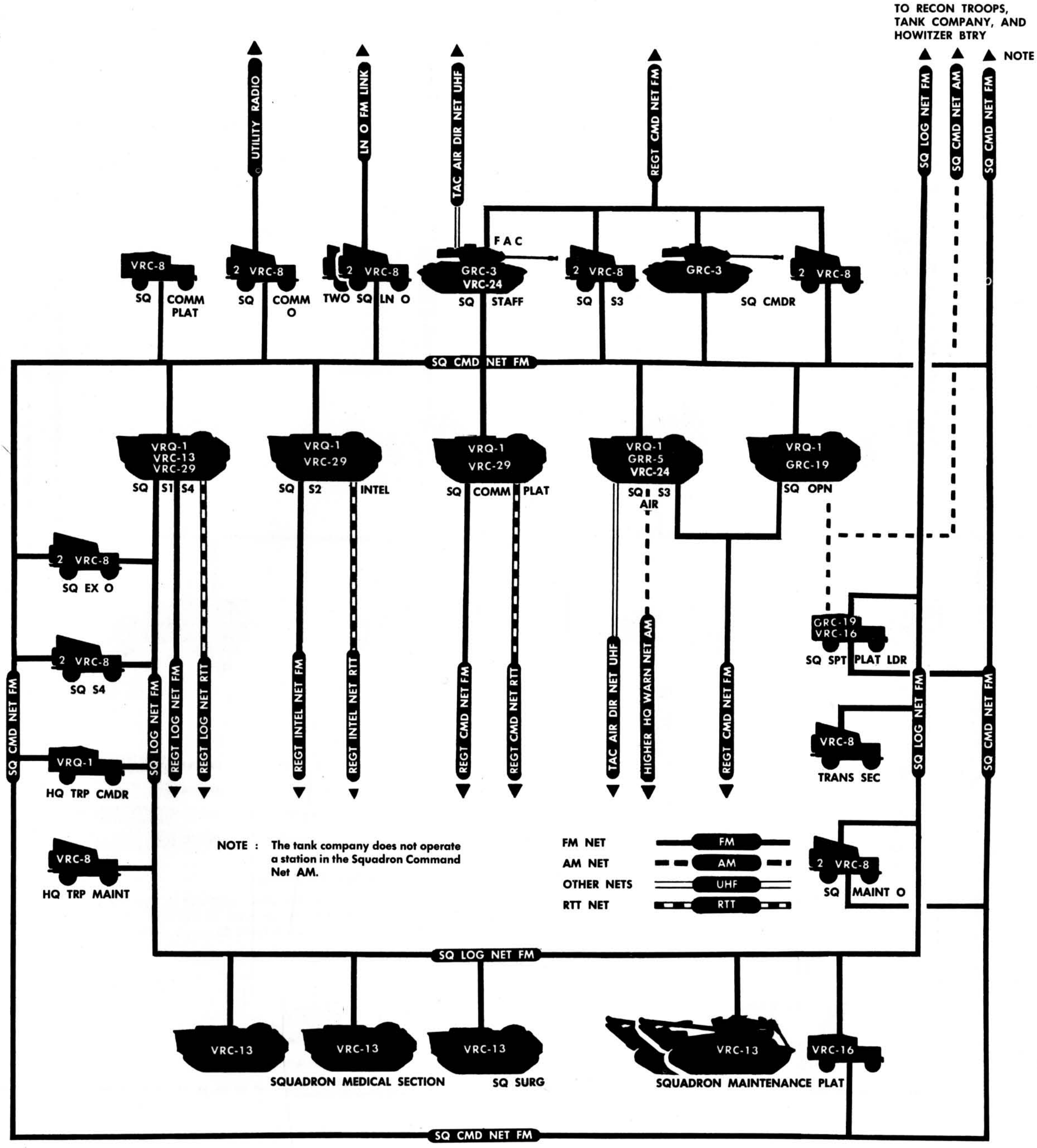
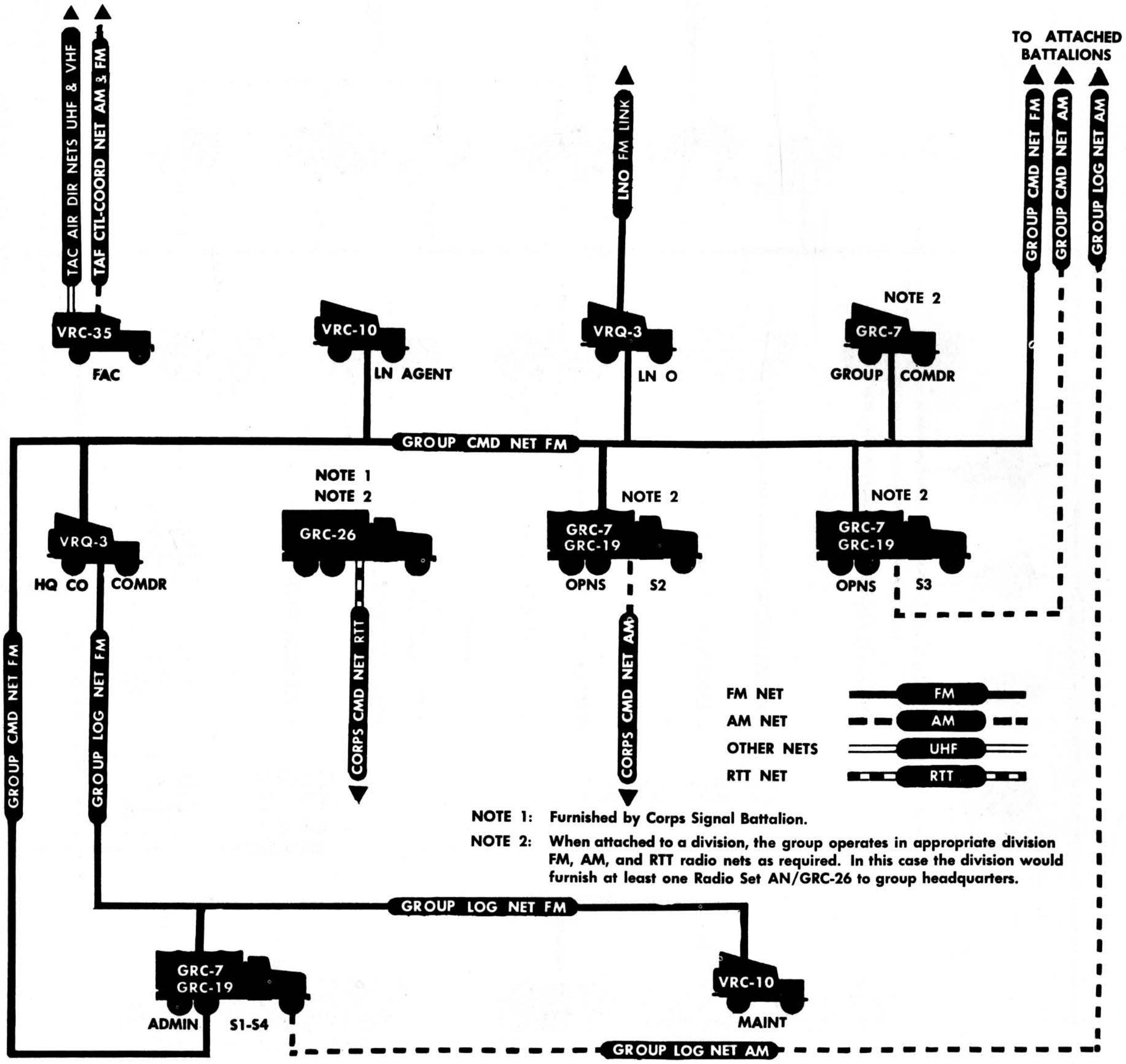


Figure 102. Type radio net diagram, aviation troop, armored cavalry regiment.



NOTE : The tank company does not operate a station in the Squadron Command Net AM.

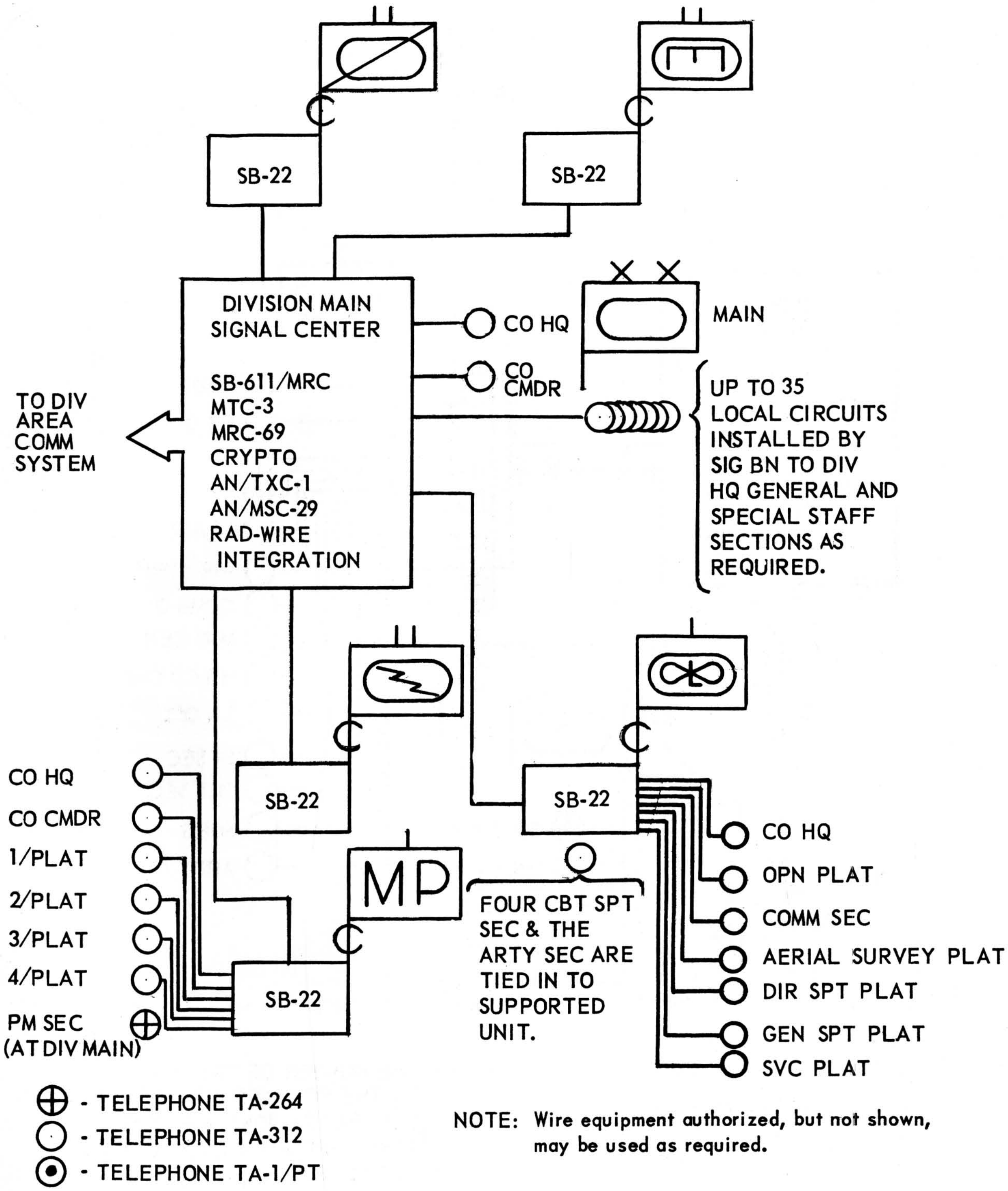
Figure 103. Type radio net diagram, headquarters and headquarters troop, armored cavalry squadron, armored cavalry regiment.



NOTE 1: Furnished by Corps Signal Battalion.

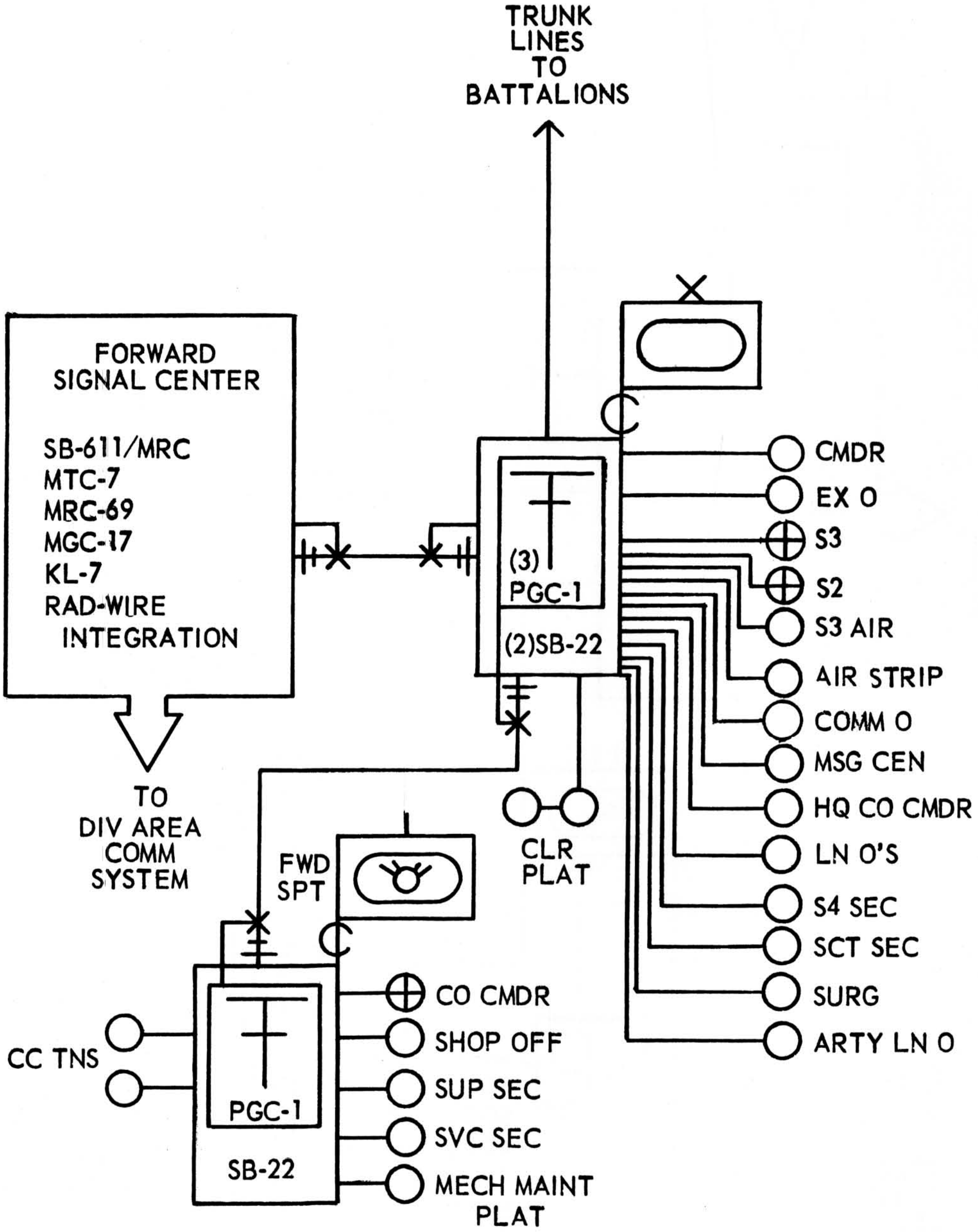
NOTE 2: When attached to a division, the group operates in appropriate division FM, AM, and RTT radio nets as required. In this case the division would furnish at least one Radio Set AN/GRC-26 to group headquarters.

Figure 104. Type radio net diagram, headquarters and headquarters company, armor group.



NOTE: Wire equipment authorized, but not shown, may be used as required.

Figure 105. Type wire net diagram, armored division headquarters area.



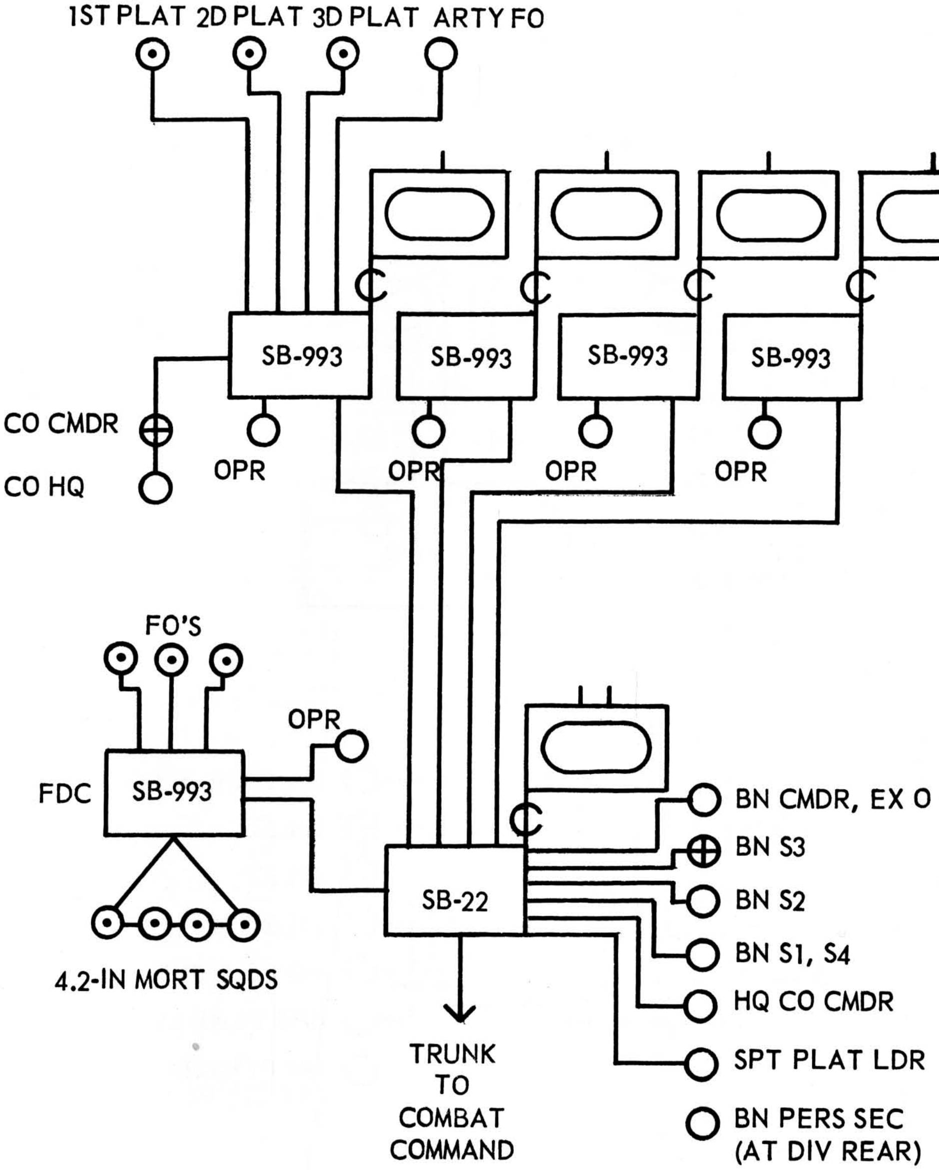
⊕ - TELEPHONE TA-264

○ - TELEPHONE TA-312

⊙ - TELEPHONE TA-1/PT

NOTE: THE NUMBER OF TRUNK LINES TO THE FORWARD SIGNAL CENTER, BATTALIONS, AND FORWARD SUPPORT COMPANY ARE INSTALLED AS REQUIRED.

Figure 106. Type wire net diagram, armored division combat command area.



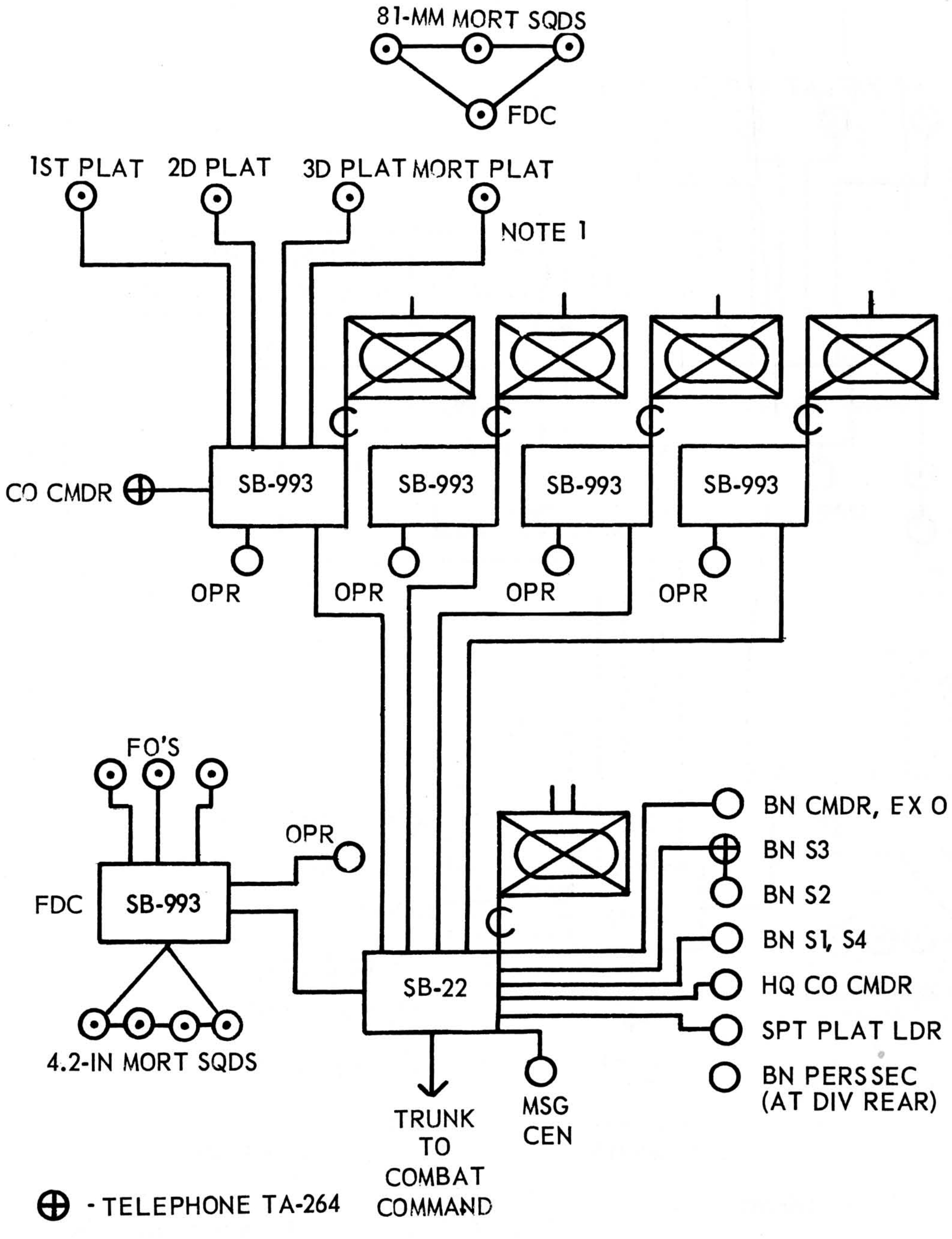
⊕ - TELEPHONE TA-264

○ - TELEPHONE TA-312

⊙ - TELEPHONE TA-1/PT

NOTE: CIRCUITS TO ATTACHED, SUPPORTING, AND ADJACENT UNITS ARE PROVIDED AS REQUIRED. LOCAL CIRCUITS MAY BE PARTY LINED WHEN NECESSARY.

Figure 107. Type wire net diagram, armored division armor battalion.



⊕ - TELEPHONE TA-264

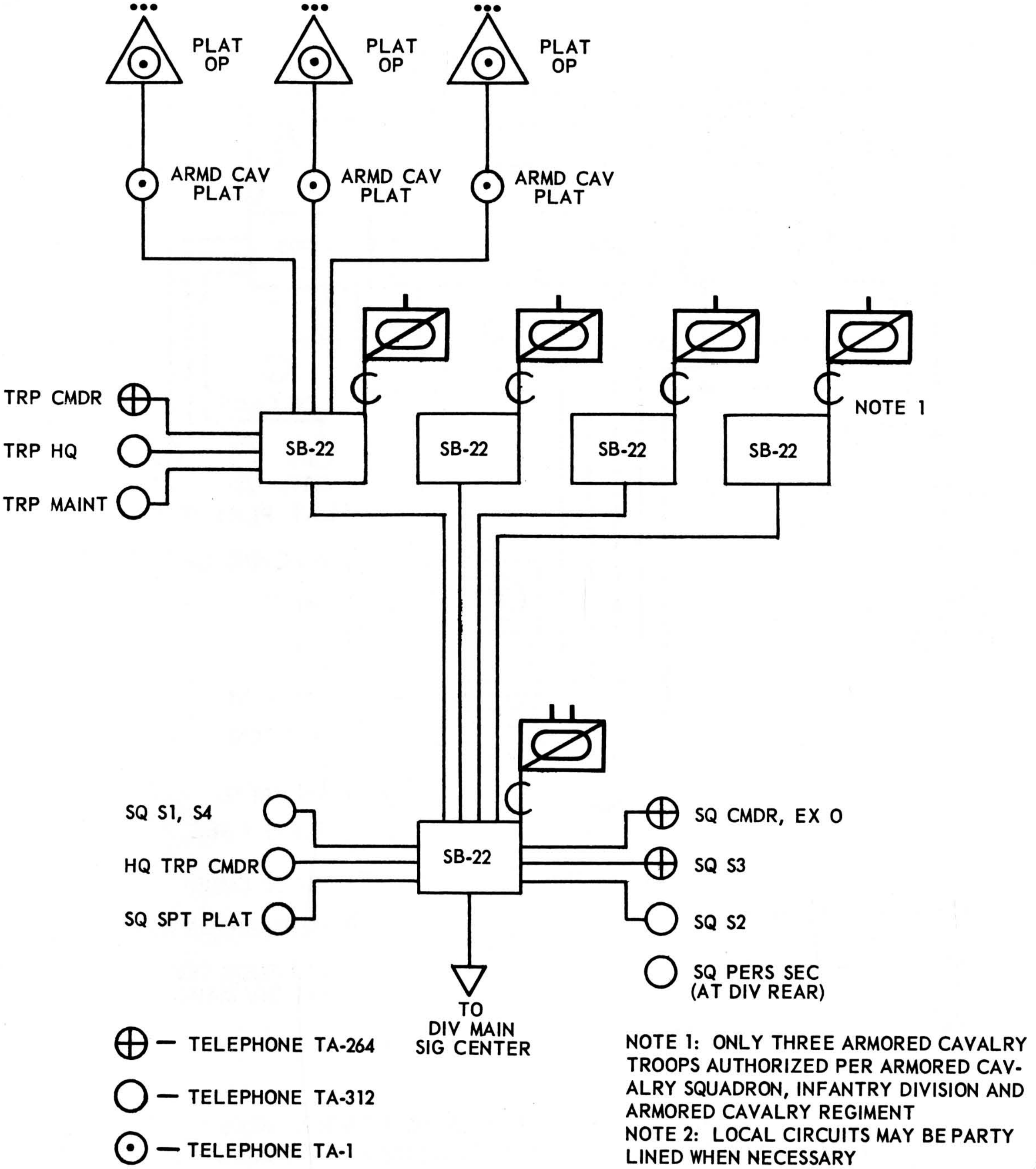
○ - TELEPHONE TA-312

⊙ - TELEPHONE TA-1/PT OR RL CE-11

NOTE 1: AUTHORIZED IN CO HQ.

NOTE 2: CIRCUITS TO ATTACHED, SUPPORTING, AND ADJACENT UNITS ARE PROVIDED AS REQUIRED. LOCAL CIRCUITS MAY BE PARTY LINED WHEN NECESSARY.

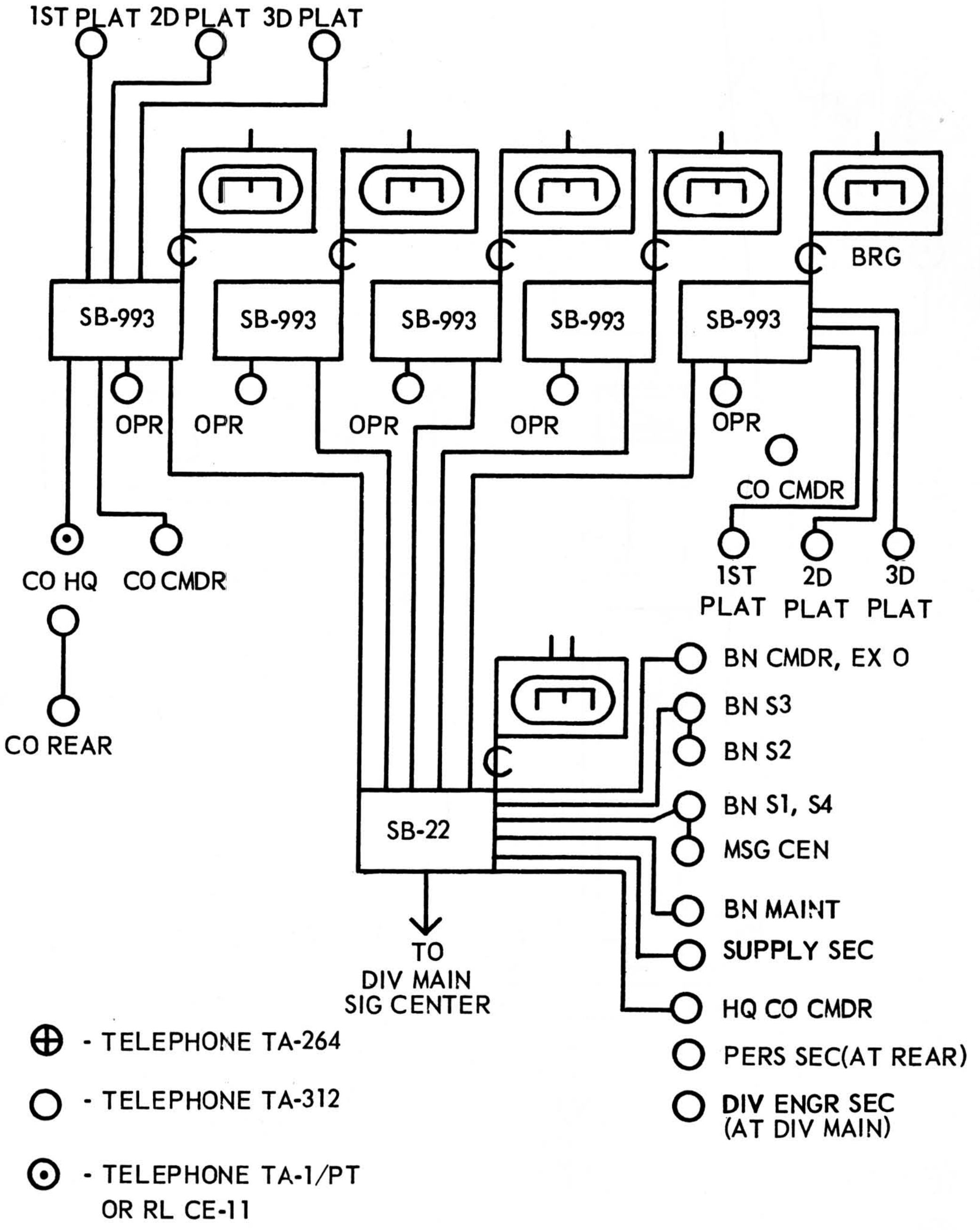
Figure 108. Type wire net diagram, armored division armored infantry battalion.



NOTE 1: ONLY THREE ARMORED CAVALRY TROOPS AUTHORIZED PER ARMORED CAVALRY SQUADRON, INFANTRY DIVISION AND ARMORED CAVALRY REGIMENT

NOTE 2: LOCAL CIRCUITS MAY BE PARTY LINED WHEN NECESSARY

Figure 109. Type wire net diagram, armored cavalry squadron(s).



NOTE: BRIDGE COMPANY IS AUTHORIZED 1 SB-18, 1 TA-312, AND 6 TA-1/TT'S (NOT SHOWN) FOR DISPLACEMENT OR AS REQUIRED AT BRIDGE SITES. THE BATTALION COMMUNICATION SECTION IS AUTHORIZED 1 SB-18 AND 9 TA-1/TT'S (NOT SHOWN) AS REQUIRED FOR USE AT WORK SITES THROUGHOUT THE BATTALION.

Figure 110. Type wire net diagram, armored division engineer battalion.

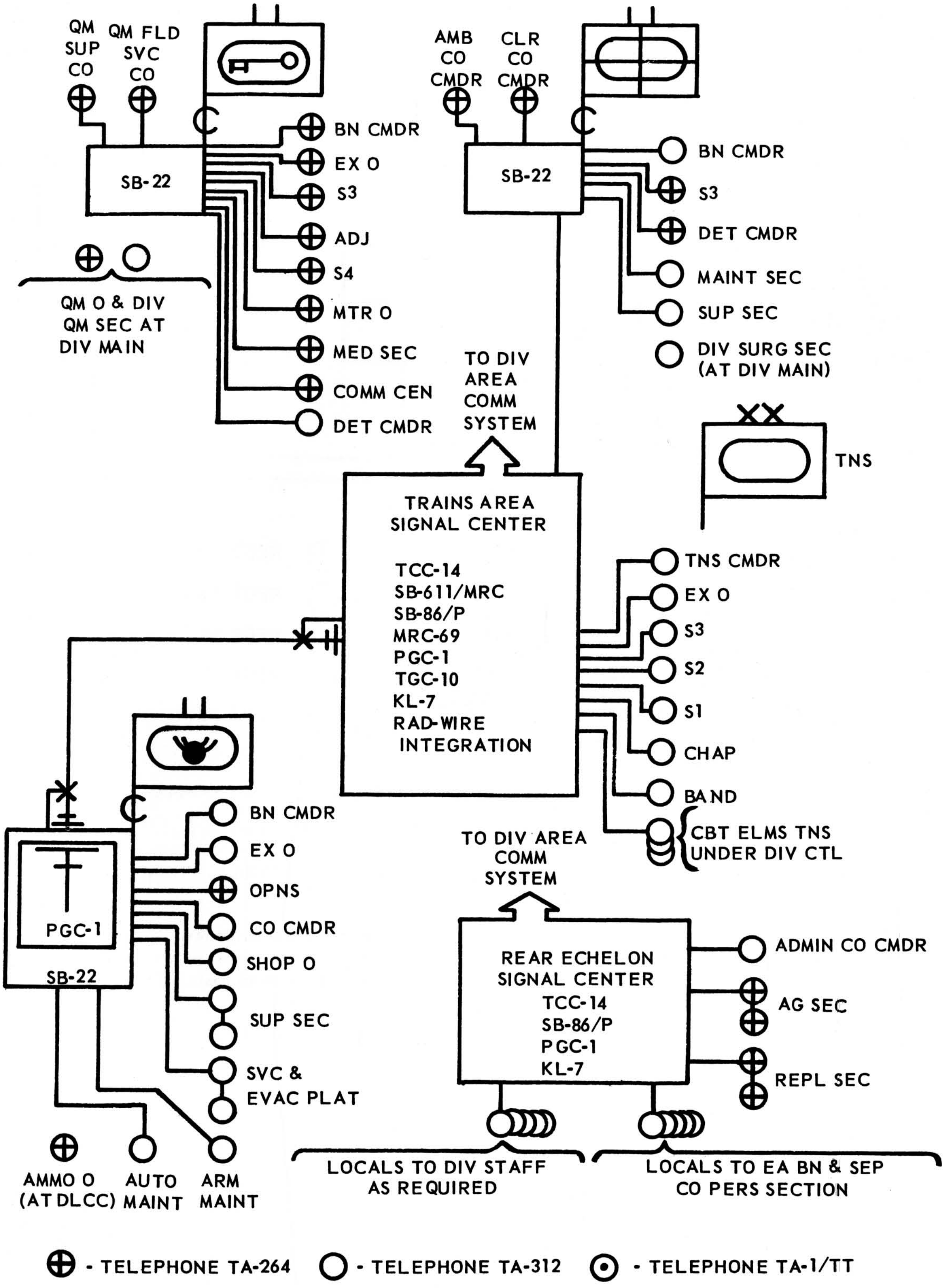
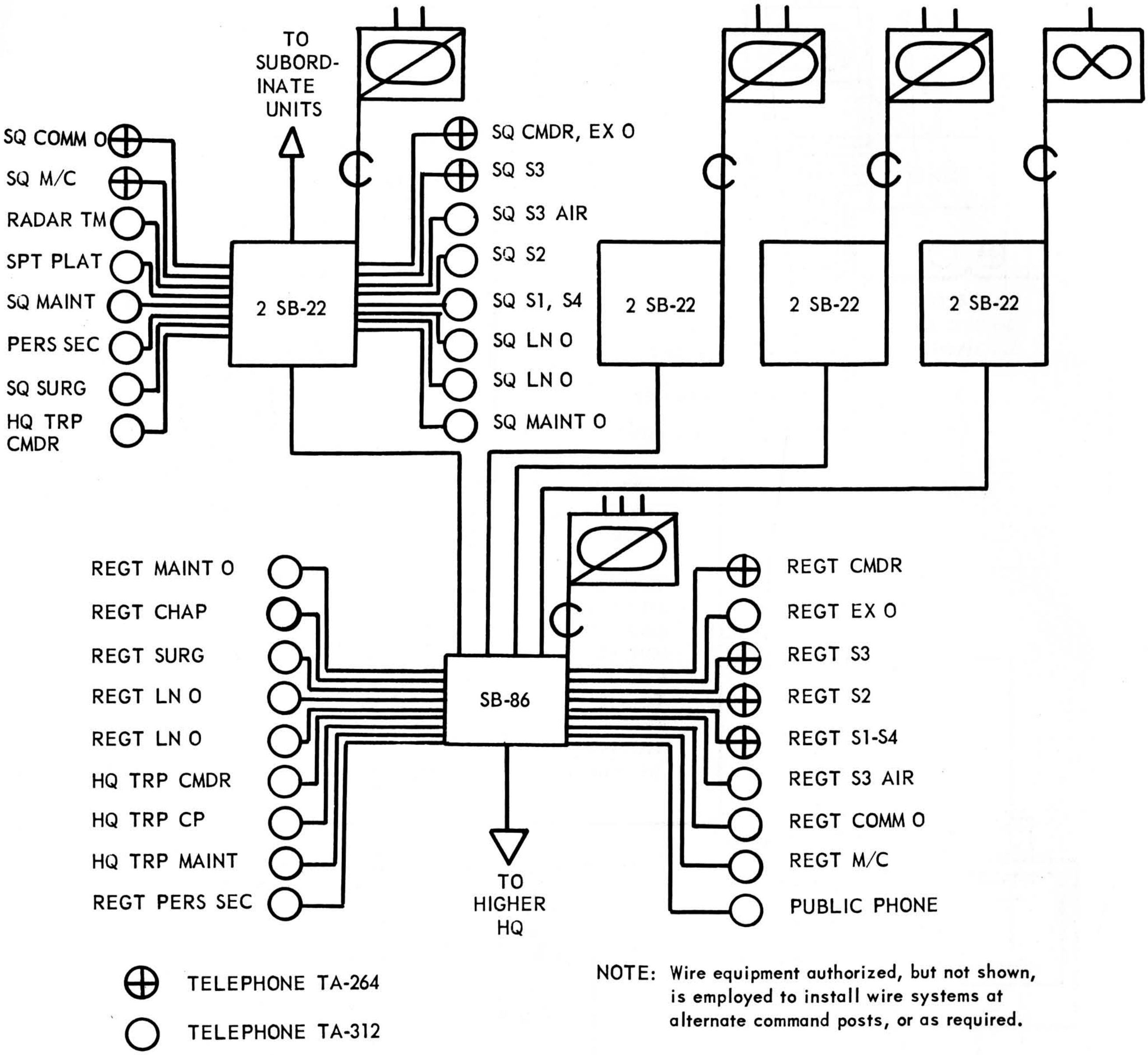


Figure 111. Type wire net diagram, armored division trains and rear echelon area.



NOTE: Wire equipment authorized, but not shown, is employed to install wire systems at alternate command posts, or as required.

Figure 112. Type wire net diagram, headquarters and headquarters troop, armored cavalry regiment; and headquarters and headquarters troop, armored cavalry squadron, armored cavalry regiment.

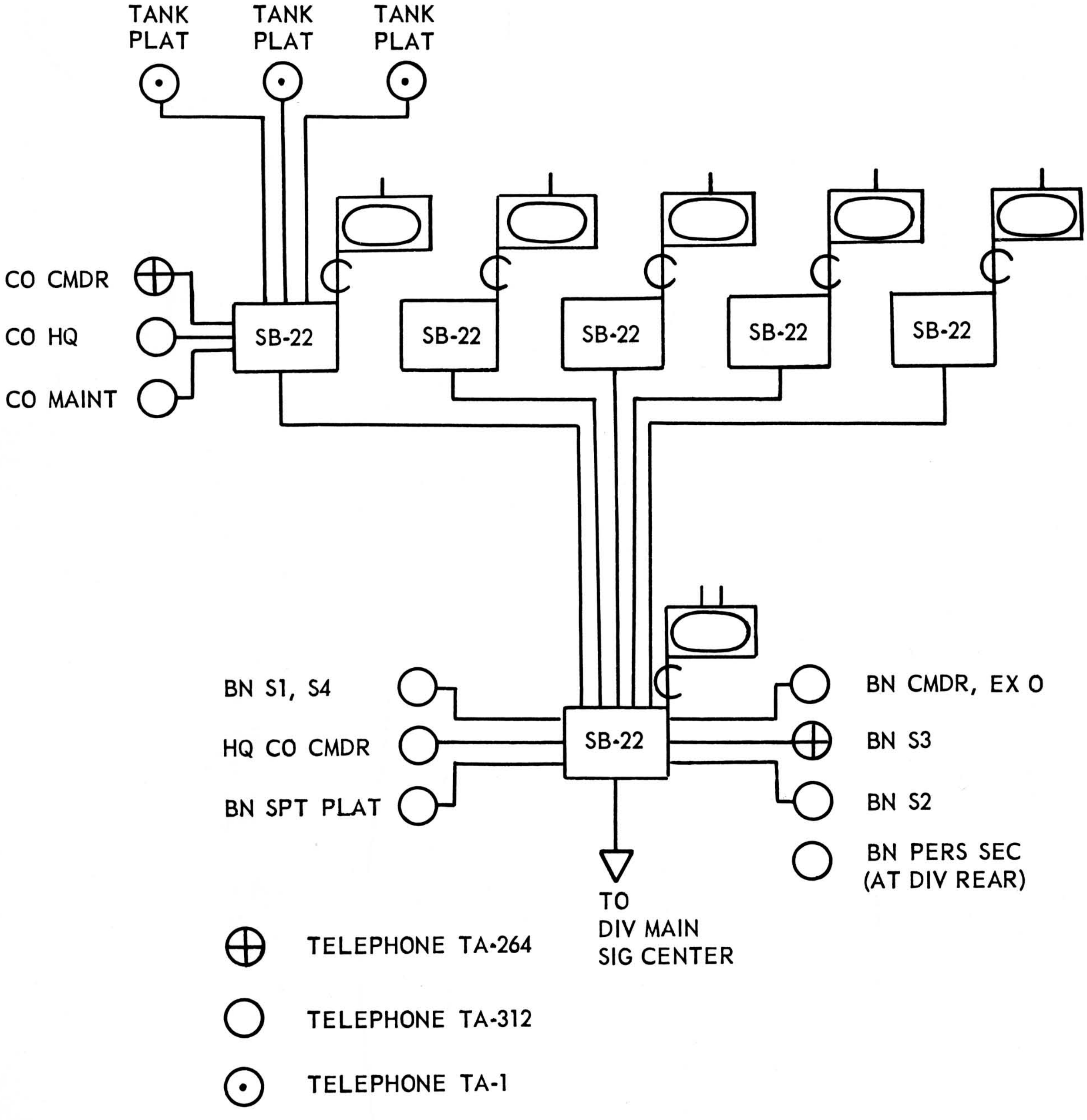


Figure 113. Type wire net diagram, infantry division armor battalion, 90-mm.

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PHONETIC ALPHABET

PRONUNCIATION OF LETTERS AND FIGURES—To distinguish figures from words similarly pronounced, the proword figures may be used preceding such numbers.

a. When necessary to identify any letter of the alphabet, the standard phonetic alphabet shall be used:

(AR 105 - 30)

LETTER	WORD	PRONUNCIATION
A	ALFA	AL FAH
B	BRAVO	BRAH VOH
C	CHARLIE	CHAR LEE
D	DELTA	DELL TAH
E	ECHO	ECK OH
F	FOXTROT	FOKS TROT
G	GOLF	GOLF
H	HOTEL	HOH TELL
I	INDIA	IN DEE AH
J	JULIETT	JEW LEE ETT
K	KILO	KEY LOH
L	LIMA	LEE MAH
M	MIKE	MIKE
N	NOVEMBER	NO VEM BER
O	OSCAR	OSS CAH
P	PAPA	PAH PAH
Q	QUEBEC	KEH BECK
R	ROMEO	ROW ME OH
S	SIERRA	SEE AIR RAH
T	TANGO	TANG GO
U	UNIFORM	YOU NEE FORM
V	VICTOR	VIK TAH
W	WHISKEY	WISS KEY
X	X-RAY	ECKS RAY
Y	YANKEE	YANG KEY
Z	ZULU	ZOO LOO

b. When figures are to be transmitted, their pronunciation will be as follows:

FIGURE	SPOKEN AS	FIGURE	SPOKEN AS
0	Zero	5	Fi-yiv
1	Wun	6	Six
2	Too	7	Seven
3	Thu-ree	8	Ate
4	Fo-wer	9	Niner

c. Figures will be transmitted digit by digit, except that exact multiples of hundreds and thousands may be spoken as follows:

FIGURE	SPOKEN AS	FIGURE	SPOKEN AS
44	Fo-wer-Fo-wer	1478	Wun Fo-wer Seven Ate
90	Niner Zero	7000	Seven Thow-zand
136	Wun Thu-ree Six	16000	Wun Six Thow-zand
500	Fi-yiv Hun-dred	81286	Ate Wun Too Ate Six